MACHINERY

NOVEMBER 29, 1961 ONE SHILLING & THREEPENCE

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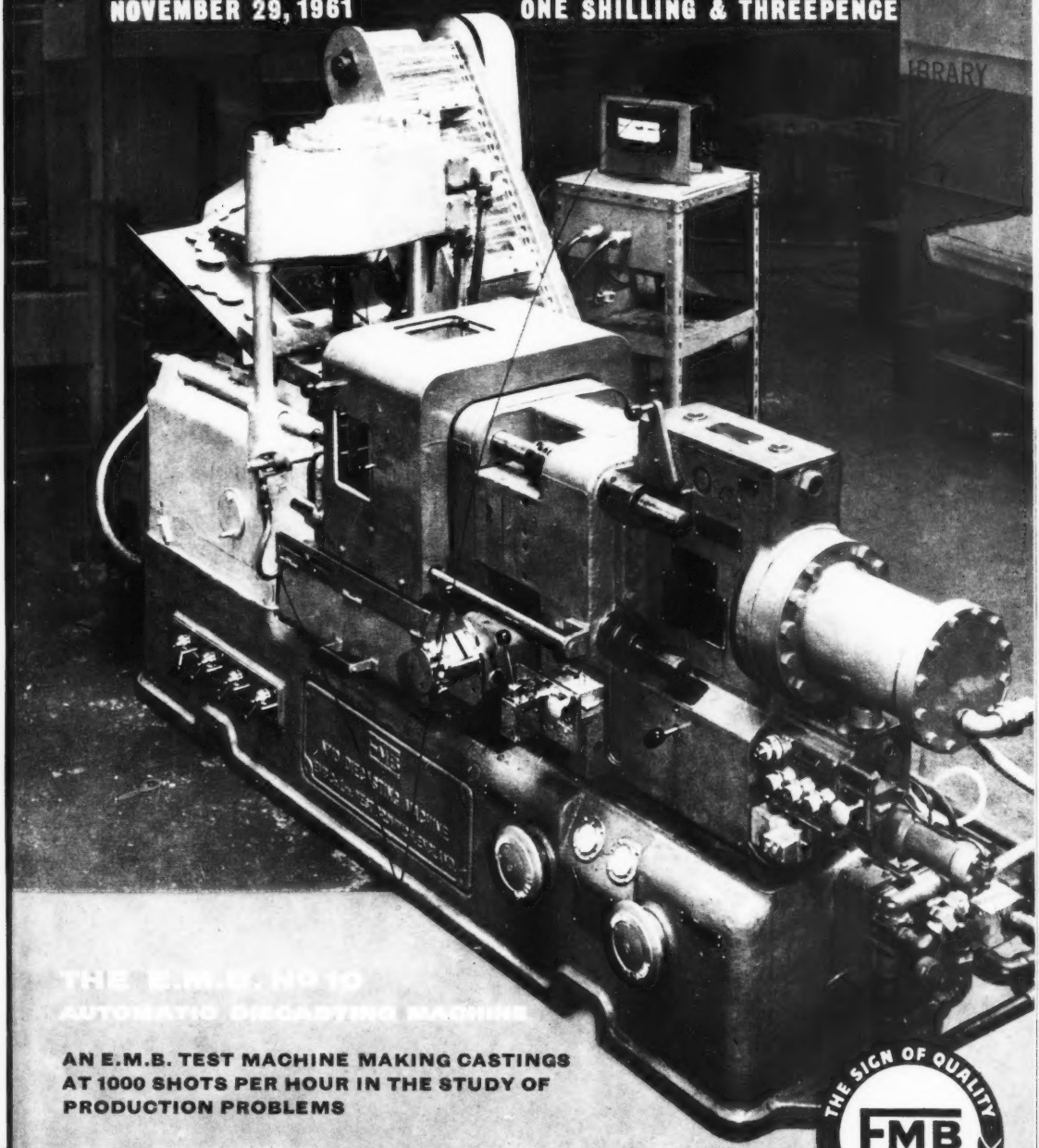

THE E.M.B. NO 10
AUTOMATIC DIECASTING MACHINE

AN E.M.B. TEST MACHINE MAKING CASTINGS
AT 1000 SHOTS PER HOUR IN THE STUDY OF
PRODUCTION PROBLEMS

E.M.B. CO. LTD. West Bromwich, England

Phone: WEST BROMWICH 1171 (6 lines)

THE SIGN OF QUALITY
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ESTABLISHED 1908

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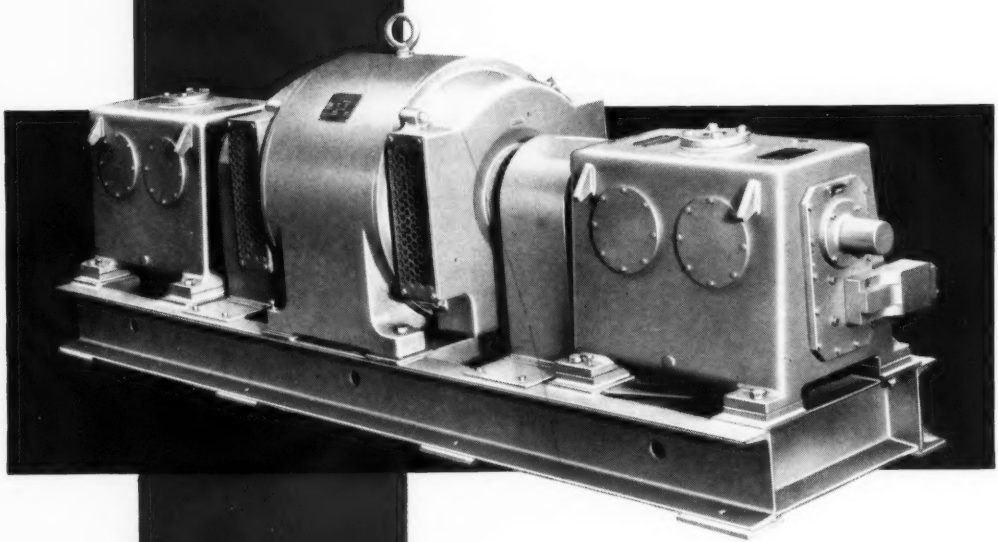
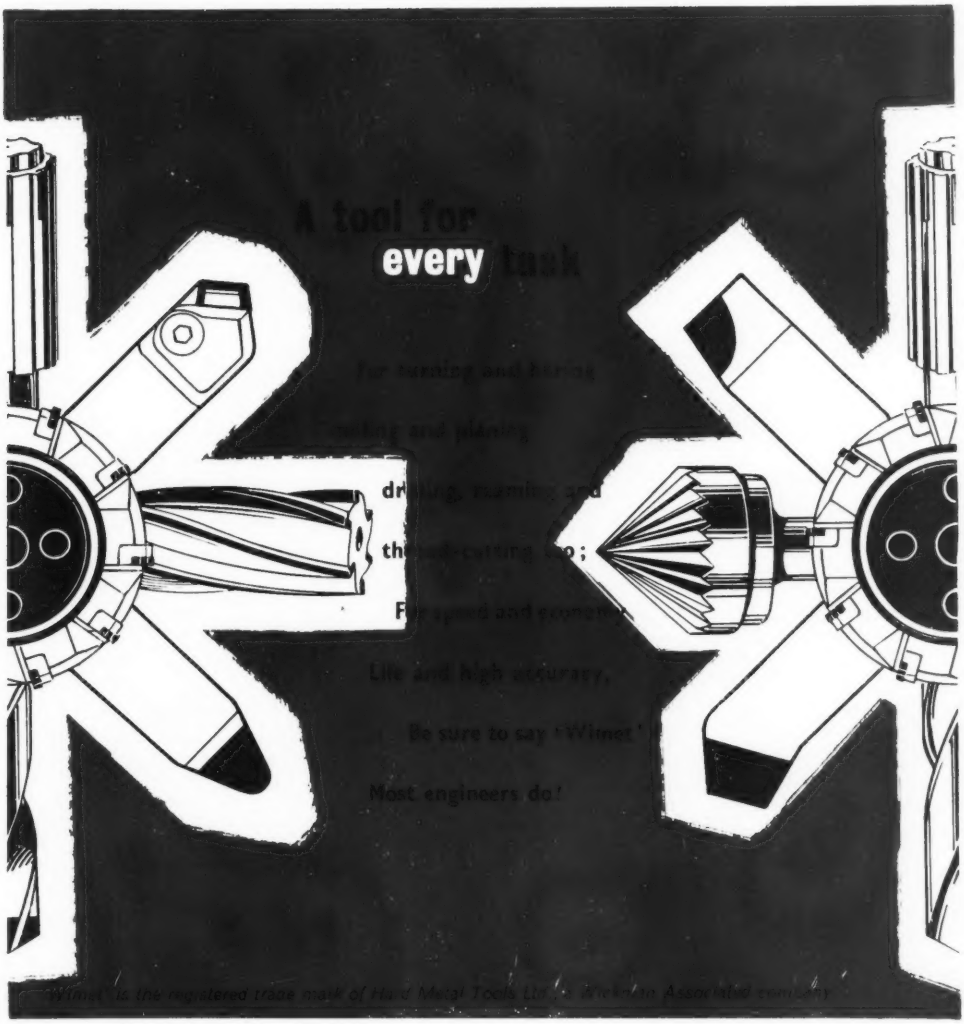


TOWLER HYDRAULIC SYSTEMS

ELECTRAULIC
AUTODRAULIC

TOWLER BROTHERS (PATENTS) LTD.
RODLEY, near LEEDS, ENGLAND
Tel: Pudsey 3125/6/7 Grams: "Electrolic" Rodley



Wimet

CEMENTED CARBIDE CUTTING TOOLS

WICKMAN LIMITED

Wimet Division, Torrington Avenue, Coventry. Tel. Tile Hill 66621

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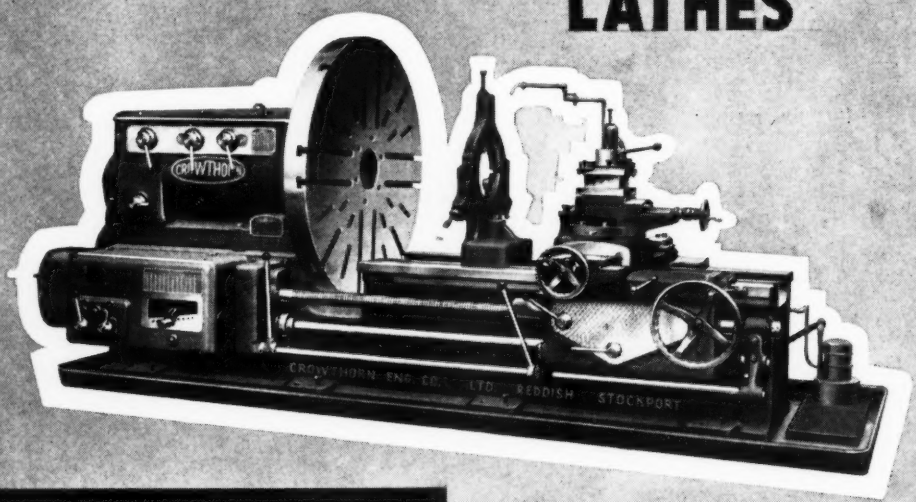
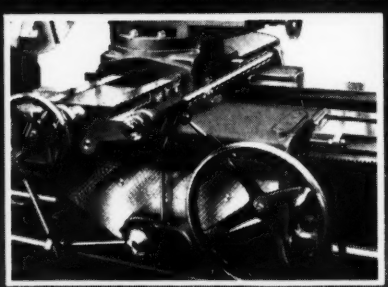
CROWTHORN

HEAVY DUTY BORING AND FACING LATHES





The illustrations are of a Crowthorn 36 in. swing Boring and Facing Lathe with, inset, detail of the automatic feed trip mechanism.

Features include:

1. Heavy design for rigidity and accuracy.
2. Square or hexagon turrets.
3. Tailstock available if required.
4. Large capacity gap 57 in. swing × 21 in. width with two removable gap pieces.
5. 30 in. swing model also available.

CROWTHORN ENGINEERING COMPANY LIMITED

Makers of High Class Machine Tools for over half a century

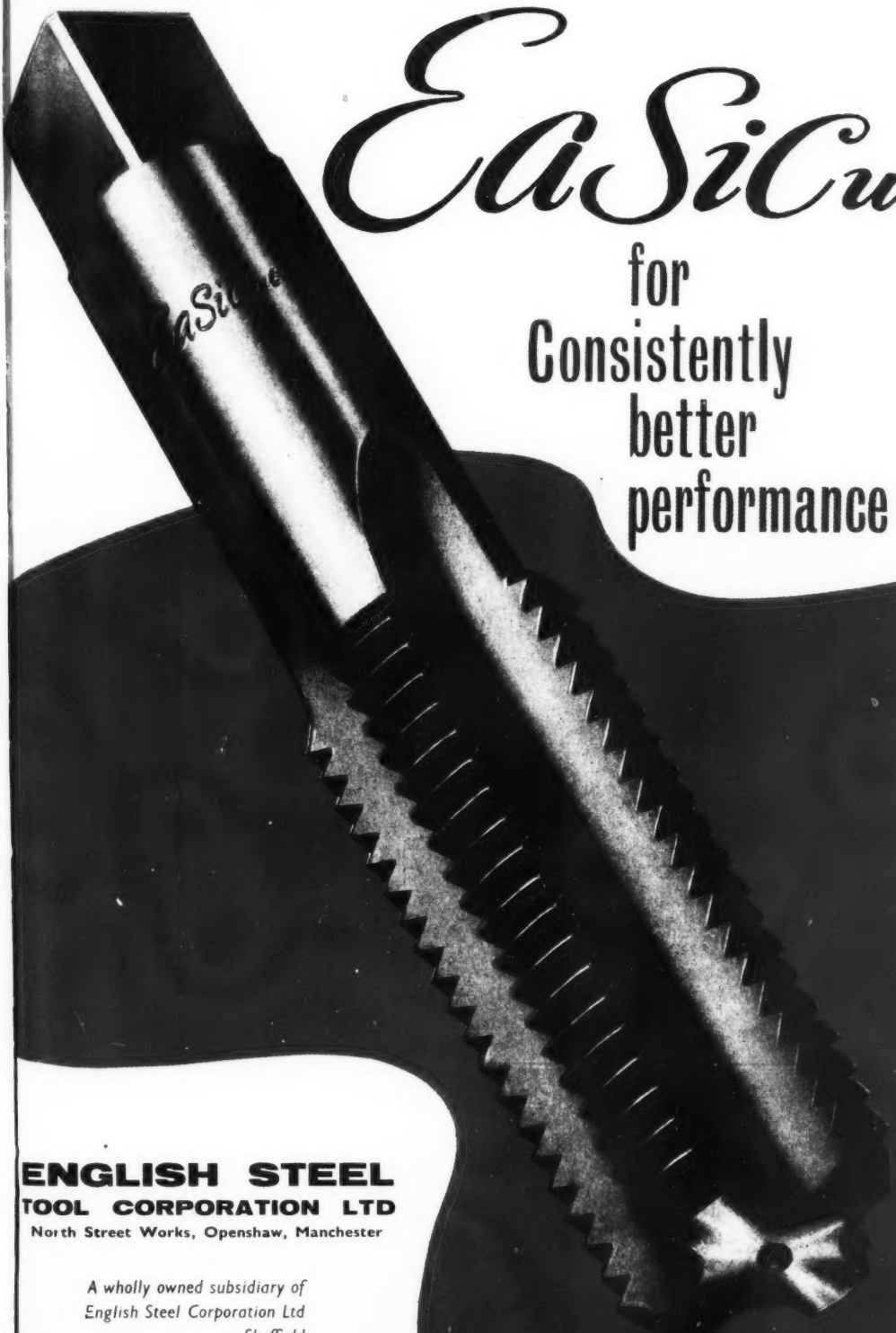
REDDISH · STOCKPORT · ENGLAND

Phone: STOCKPORT 7271-2-3 *Grams: CROWTOOL, REDDISH*

CL 99

EaSiCut

for Consistently better performance

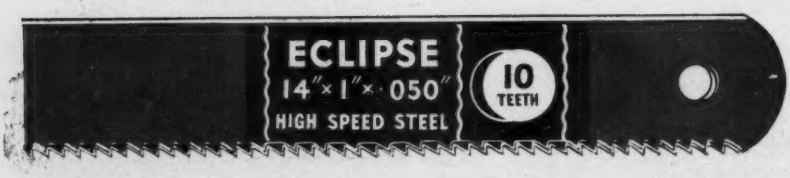


ENGLISH STEEL
TOOL CORPORATION LTD
North Street Works, Openshaw, Manchester

A wholly owned subsidiary of
English Steel Corporation Ltd
Sheffield

I agree... for speed and long life

order Eclipse



Made by James Neill & Co. (Sheffield) Ltd., and obtainable from all tool distributors

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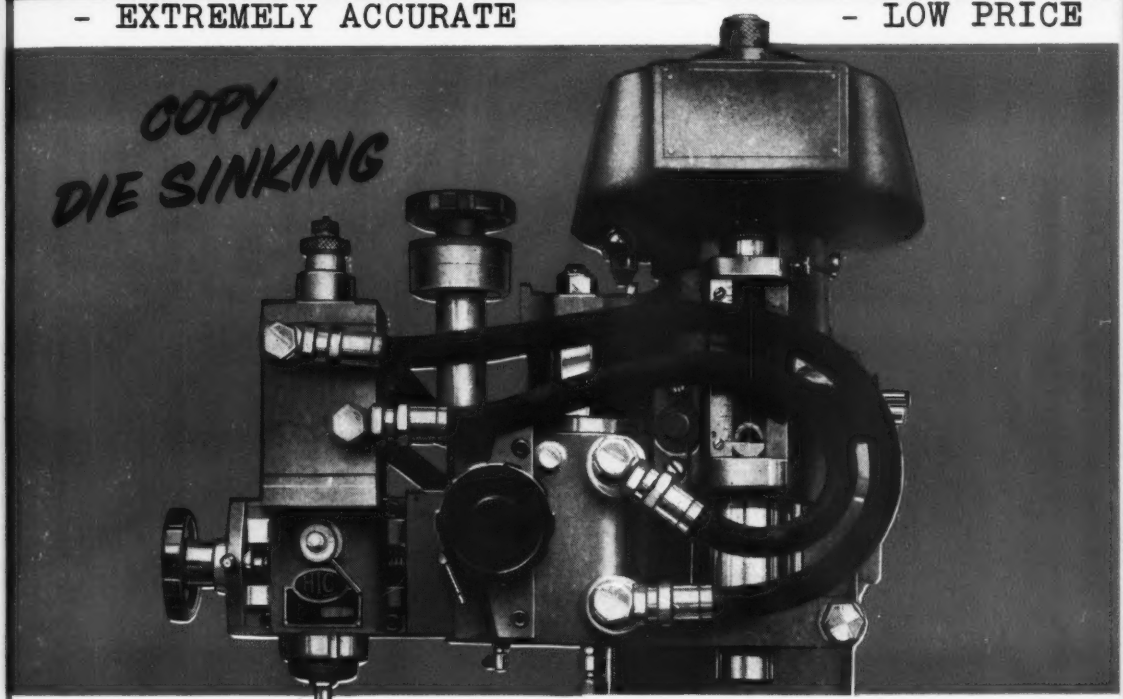
HYDRAULIC COPYING ATTACHMENT - FITS MOST TYPES

- EXTREMELY ACCURATE - LOW PRICE

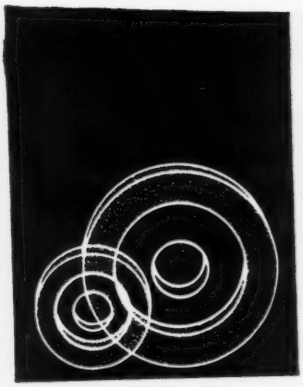


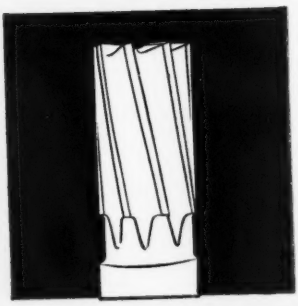
- Can be fitted in approximately fifteen minutes.
- Can be removed for normal machining.
- Does not impede the normal use of the machine in any way.
- Light stylus pressure.
- Adapted to any quill type machine.
- Suitable for all types of die sinking work.
- Can be fitted to both new and old machines.
- Unequalled accuracy.
- Many users claim ±.001in. accuracy.
- No additional parts required. Price includes pump unit, pipes, etc.

Type 600 D.S.....£310
Type 250 D.S.....£275

HEPWORTH
hydraulic copying equipment

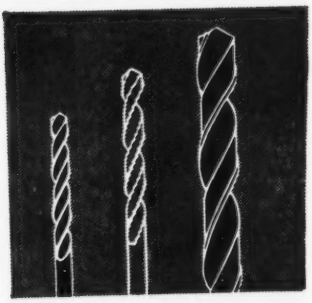
THE HEPWORTH IRON COMPANY (Engineering) LIMITED
industrial hydraulic mechanisms
Hazlehead Nr. Sheffield
telephone Penistone 3342 3 telegrams Carlecotes, Penistone





Engineers'

Tools



Monks & Crane Ltd

BRITAIN'S FOREMOST DISTRIBUTORS

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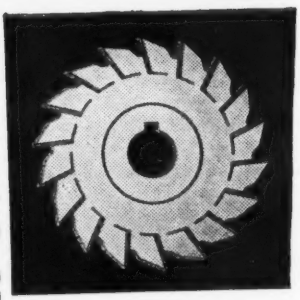
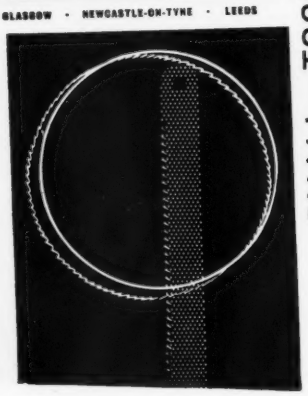
SMALL TOOLS DIVISION





SM/MC 6598

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One Vauxhall cluster gear blank handled automatically and machined for gear cutting every 45 seconds!

Ryder

does it this way . . .

At Vauxhall Motors Ltd., Luton, a RYDER 8-station No. 10 Verticalauto completes all exterior machining of cluster gear blanks automatically in two distinct sequences. The two loading arms work simultaneously, lifting the components from the conveyor and returning them on completion of each stage. Here is all the speed, precision and control associated with special equipment—achieved on a standard machine fitted with auto loading and unloading. The versatile No. 10 Verticalauto, with its great work capacity and ability to reduce labour costs can surely solve a production problem for you. Six-spindle and twin-six-spindle models are also available and are equally flexible in their adaptability.

THOMAS RYDER & SON LIMITED,
TURNER BRIDGE WORKS,
BOLTON, ENGLAND.

See *Ryder*

about automatics and auto-handling

When answering advertisements kindly mention MACHINERY.

new SIP jig boring machine

specially designed for YOUR tool room and production shop

To meet the varied requirements of the engineering industry
SIP have developed the new MP-5E jig boring machine.
Modern, robust, containing many advanced features,
it makes SIP precision and enduring accuracy
available at very low cost.
Incorporating the proven Double Column frame design,
automatically corrected leadscrews,
powerful Spindle Head containing SIP taper roller bearings,
the MP-5E is a dependable and versatile machine,
easy to operate, economical to maintain.
The SIP guaranteed accuracy for all displacements of
Work Table and Spindle Head is 0·0002".

Specifications and full information available from
SOCIETE GENEVOISE LTD

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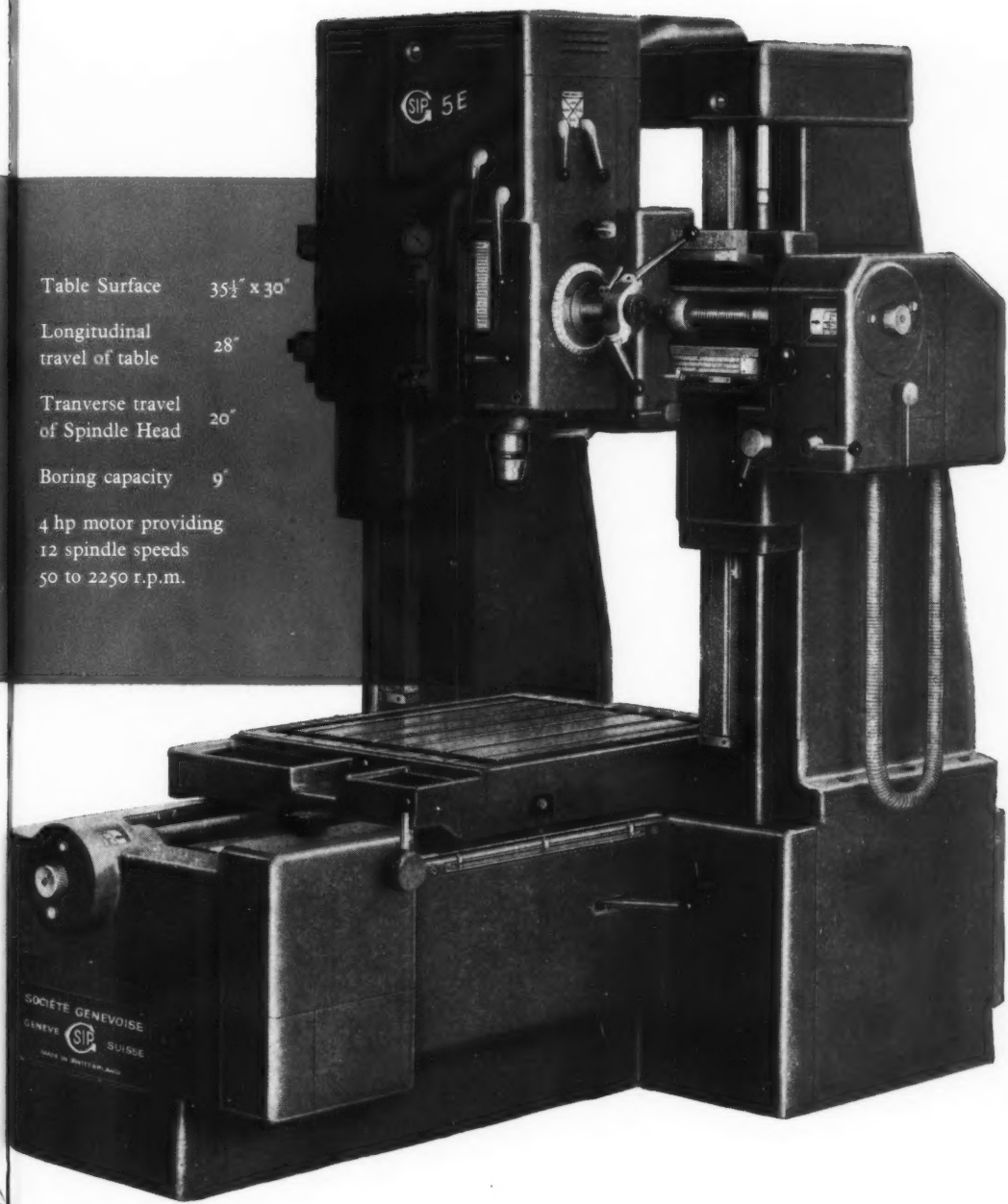

Table Surface	35½″ x 30″
Longitudinal travel of table	28″
Tranverse travel of Spindle Head	20″
Boring capacity	9″

4 hp motor providing
12 spindle speeds
50 to 2250 r.p.m.

NEWPORT PAGNELL BUCKS ***Telephone: Newport Pagnell 460/1/2***

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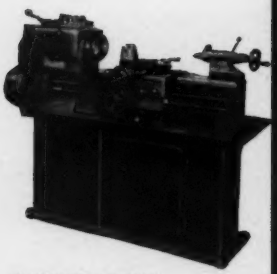
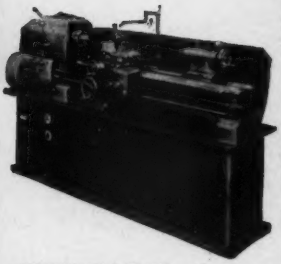


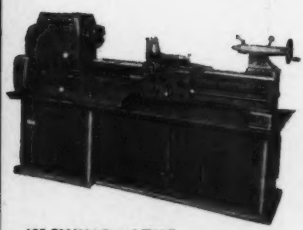
9" SWING LATHE

4½" centres. Between centres 24". 8-speed all-geared head. 1½ h.p. motor. Available with extras such as quick change gearbox with 36 speeds and feeds and bed to admit 40" centres.
Basic price £345.



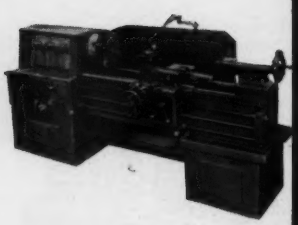
12" SWING LATHE

6" centres. Between centres 24" or 40". Speeds and feeds 36. Spindle speeds 45-1000, 34-1500 or 45-2000.
Basic price £475.
With copying equipment:
Basic price £815.



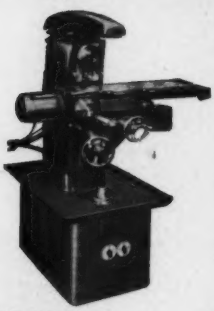
13" SWING LATHE

6½" centres. Between centres 40". Spindle speeds 9 or 18. Speed range 35-750, 59-1250, 41-1750.
Basic price £645.
With copying equipment:
Basic price £995.



17" SWING LATHE

8½" centres. Between centres 40". Spindle speeds 12. Speed range 35-1500. **Basic price £1350.**
With copying equipment:
Basic price £1800.



HORIZONTAL MILLING MACHINE

With longitudinal power to table 30" x 8". Traverse: longitudinal 15", cross 6½". All-geared drive, 2 h.p. motor with clutch and brake. Eight speeds 67-1500. **Basic price £415.**
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DOUBLE ENDED, GENERAL PURPOSE GRINDER

Can be supplied with coolant, eye shields, twist drill attachment or arranged for side grinding. Standard model 14" x 2" wheels, 3 h.p. motor.
Basic price £131.10.0.

the Harrison range – a businesslike equation of price and performance.....

Harrison policy is to provide productive capacity and reliability well above price. Ask for literature and assess this claim.

Literature available covers the Harrison range of lathes from 9 to 17 swing; Milling, Drilling, Grinding, Lapping Machines; Engineers' Accessories.

TICK THE MACHINES THAT INTEREST YOU AND ATTACH THIS ADVERTISEMENT TO YOUR LETTERHEAD.

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T. S. HARRISON & SONS LIMITED, HECKMONDWIKE, YORKSHIRE

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NEW MODEL "S" SUPER CHUCK

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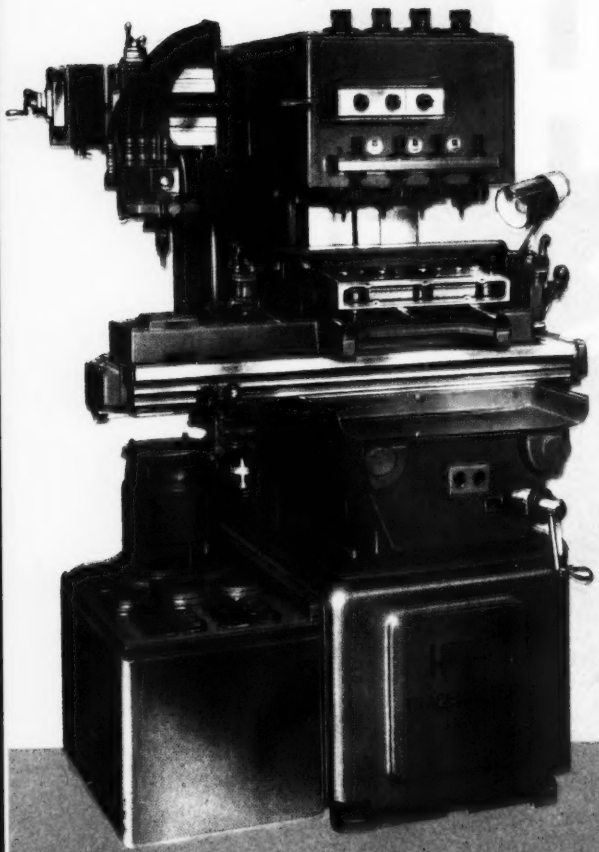
FASTER
STRONGER
MORE
ACCURATE

ClarkSon
S type AUTOLOCK

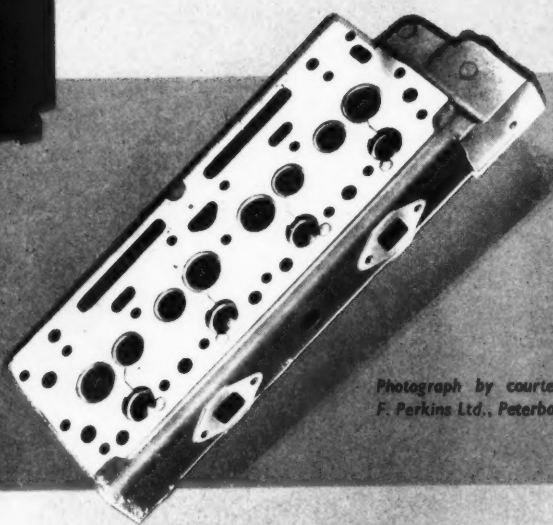
CLARKSON (ENGINEERS) LIMITED
KING EDWARD ROAD, NUNEATON WARWICKSHIRE
BRANCHES AT LONDON, CROYDON, BARKING, ENFIELD, BIRMINGHAM, BELFAST, BRISTOL, COVENTRY, LEEDS, GLASGOW, HAYES, MANCHESTER, NEWCASTLE, WOLVERHAMPTON



TYPE TM43

4-SPINDLE
TRACEMASTER

for profile milling
gas transfer grooves
in diesel cylinder heads . . .



Photograph by courtesy of
F. Perkins Ltd., Peterborough

HAYES ENGINEERS (LEEDS) LTD. GELDERD ROAD, LEEDS, 12.

PHONE: LEEDS 30941
GRAMS: TOOLMAKER, LEEDS 12

Sole Selling Agents for Home and Overseas
ASSOCIATED BRITISH MACHINE TOOL MAKERS LTD., 17 GROSVENOR GARDENS, S.W.1.

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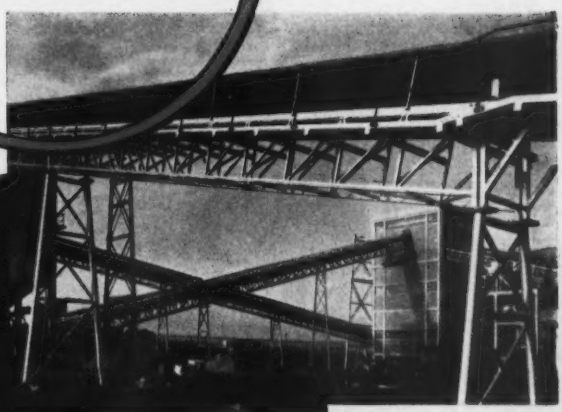
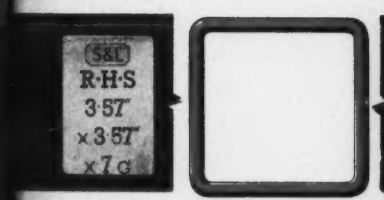
HOLLOW STRUCTURAL STEELWORK





The drawing shows one of the connections and some of the sections employed.

In these conveyor gantries, designed by Unifloc Limited and installed at Brynlliw Colliery in the South Western Division of the National Coal Board, the Rectangular Hollow Sections and tubes were supplied by Stewarts and Lloyds Limited.

The conveyor gantries built by Rees & Kirby Limited, using 22 tons of R.H.S., have spans of up to 60 ft. and a total length of 2,800 ft. The covering is supported by portal frames also made from R.H.S.

S & L technical representatives will gladly give advice where projects incorporating hollow structural steelwork are involved.

A pamphlet giving full dimensions, properties and prices of Rectangular Hollow Sections will be sent on application to Stewarts & Lloyds Limited, Structural Steel Department, Lloyd House, Colmore Circus, Ringway, Birmingham 4. Telephone: Central 3300. Telex 33333.

PRODUCT OF S&L

Manufacturers of High Quality Tools

FOR OVER A CENTURY

GEO. WALKER & SONS

(BIRMINGHAM) LTD.

WARWICK RD. TYSELEY, BIRMINGHAM, 11

Trade Mark

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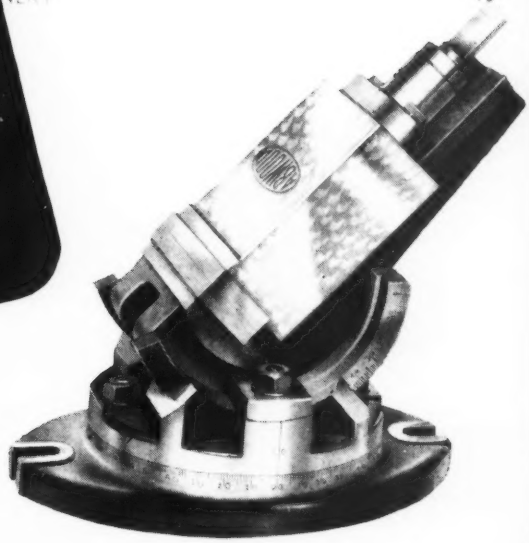
NIVERSAL MACHINE VICES AND OMPOUND ANGLE TABLES FOR ALL ACCURATE WORK



Suitable for jig boring, grinding, milling and shaping machines. Movements are fully indexed through 360° in the horizontal plane and 90° in the vertical. Any combination of angles can be obtained.

Available with 4″ and 6″ jaw widths. Accurately indexed for angular work with spot sight and knife edge for register. Note the clean design, low height and rigid mounting. Angles cannot alter once the clamps have been locked.

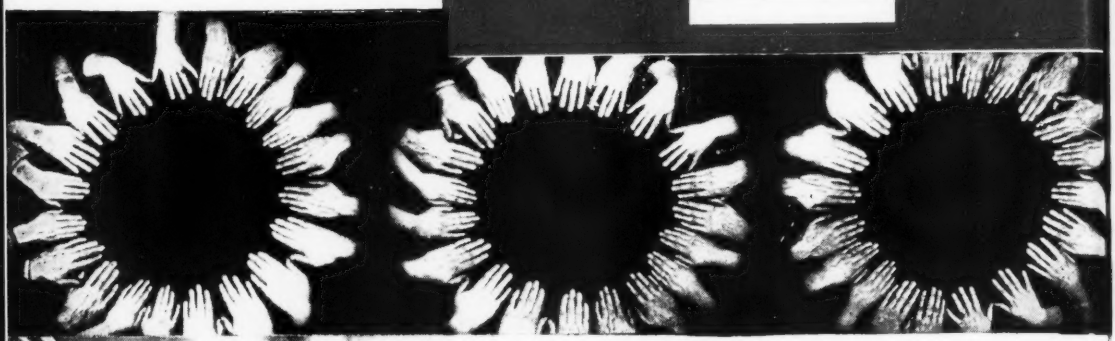
Universal table fitted with interchangeable table. Changeover from circular to rectangular table is readily effected by loosening clamping bolts.
Available in two sizes. Circular 6″ and 8″ diameter. Rectangular 8″ x 6″ and 10″ x 8″.

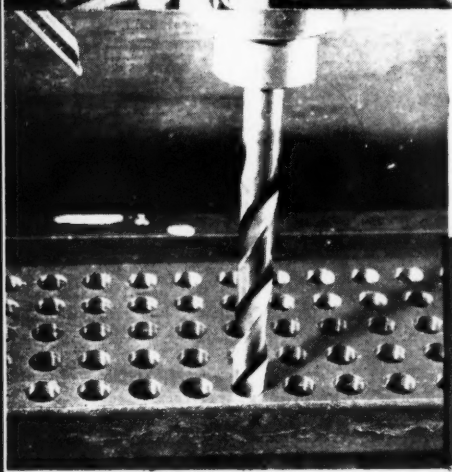
ABWOOD

BWOOD MACHINE TOOLS LTD., PRINCES ROAD, DARTFORD, KENT

Telephone: Dartford 5271/5 Telegrams: ABWOOD DARTFORD

DO YOU KNOW . . .





[redacted] It takes at least thirty people —thirty pairs of skilled hands—to make one DORMER Drill. Every operation is performed by experienced operators with the most up-to-date machinery. Careful heat-treatment and inspection are equally essential in maintaining the consistently high standard of DORMER Tools.

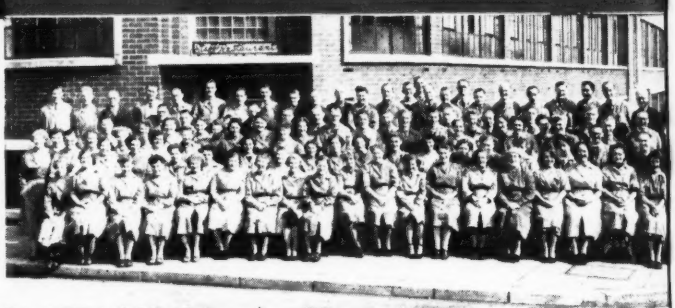
At least one in every ten people employed in the manufacture of DORMER Drills is an Inspector. Throughout production and [redacted] DORMER Twist leaves the works, every feature is

INSPECTION

checked in minute detail.

PERFORMANCE

With correct use, a DORMER Drill of 1 in. Diameter, in its lifetime on general purpose work, will remove 2,800 times its own weight in material (over $1\frac{1}{4}$ tons), and drill a total length of hole five hundred yards long!



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TWIST DRILLS

THE FINEST BY ANY STANDARD

THE SHEFFIELD TWIST DRILL AND STEEL COMPANY LIMITED
SHEFFIELD ENGLAND

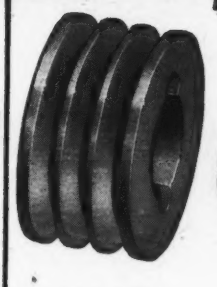
DORMER TOOLS ARE OBTAINABLE FROM YOUR USUAL ENGINEERS' MERCHANTS

61

There are no better pulleys than *Collingwood*

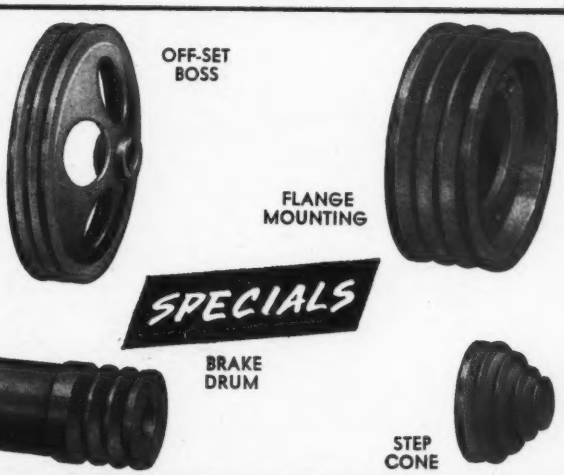
Stock Pulleys
Standard Pulleys
SPECIALS
ONE OFF OR QUANTITIES

V-BELT
COM-PAC Wedge V
LINK-V
AND SPECIAL GROOVING



Stocks of Atlas TAPER BUSHED V PULLEYS

Stock & Standard Cast Iron V-PULLEYS



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Competitive Prices and Deliveries

The London Shafting & Pulley Co. Ltd.
COLLINGWOOD IRON WORKS
18-22 NORTHDOWN STREET · KING'S CROSS · LONDON N.1.
Telephones: Terminus 4731, 4733, 4735, 6579. Telegrams: Shaftey, Kincr, London.

Attach this cut-out to your letter heading

- *Please send NEW comprehensive V-pulley catalogue*

Name.....

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Position.....

NRP 5223

30in. High Production Slotter

Butler

with electric feed and traverse unit, magnetic clutches, and complete control of all movements from pendant push button switch.

The BUTLER MACHINE TOOL Co. LTD.
HALIFAX TELEPHONE 61641 ENGLAND

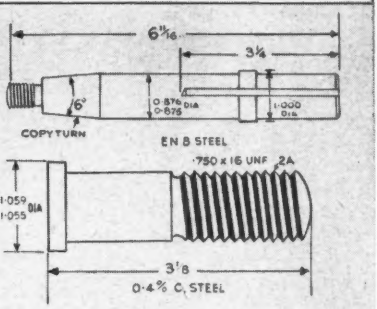
PLANERS
SHAPERS
SLOTTERS

ASSOC. BRITISH MACHINE TOOL MAKERS ABMTM LTD

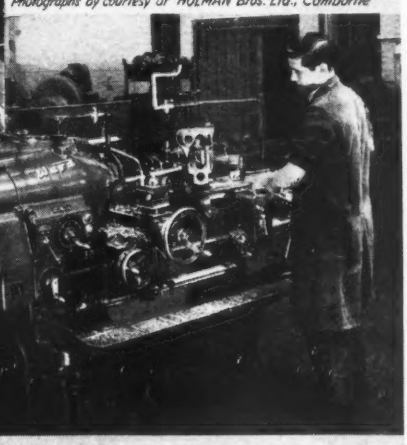
For Maximum Production

Ward 'DS'

DOUBLE-SLIDE CAPSTAN LATHES

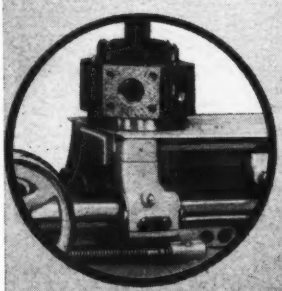


Photographs by courtesy of HOLMAN Bros. Ltd., Camborne



The New DOUBLE-SLIDE allows heavier work with higher rates of removal and provides

Greater Rigidity and Accuracy



Throughout the whole of its forward movement, the hexagonal turret is supported underneath by a sliding bridge which is in direct contact with the bed on all its working surface. This ensures correct alignment at all times, whatever weight of tools the turret carries.

SIZES AVAILABLE

	2DS	3DS	7DS
Bar Capacity with Standard Spindle	1¼ in	1½ in	2 in
with oversize Spindle	1½ in	2 in	2½ in

'PRELECTOR' No. 7 Combination Turret Lathe with Preselective speed-changing.

COMBINATION TURRET LATHES with capacities up to 35 in. swing over bed 1½ in. to 2½ in 'D-S' DOUBLE-SLIDE Capstan Lathes for heavier accurate work.

Tools, Toolholders, Chucks and Accessories for Capstan and Turret Lathes.

H. W. WARD & CO LTD

SELLY OAK, BIRMINGHAM 29

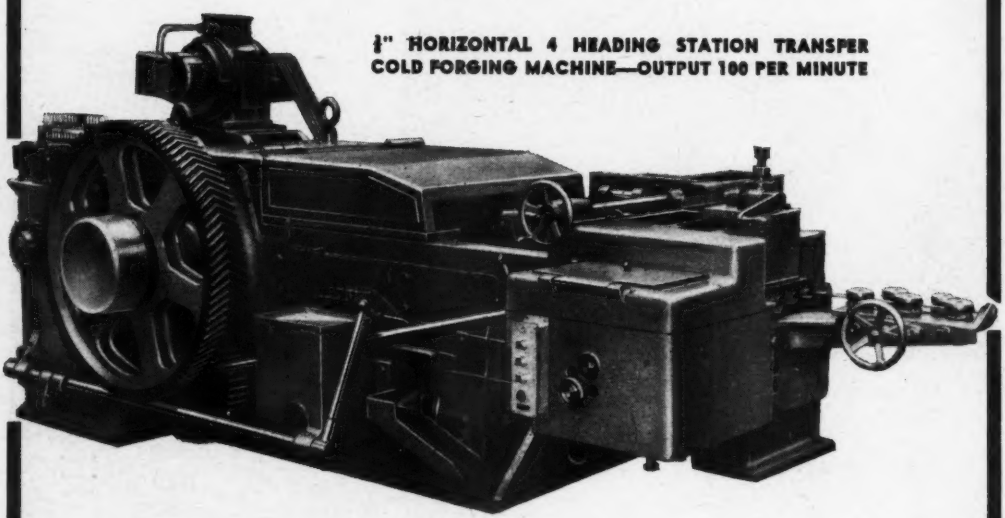
Phone: Selly Oak 1131

BRITISH MACHINE TOOL MAKERS ASSOC. LTD ABMTM

W693

B2

GREENBAT COLD FORGING MACHINERY



¾" HORIZONTAL 4 HEADING STATION TRANSFER COLD FORGING MACHINE—OUTPUT 100 PER MINUTE

This ¾" Horizontal 4-station transfer Cold Forging Machine has an output of 100 per minute. It will cut off lengths of 4½" with a cut-off capacity of 9/16" diam. on high tensile steel wire. Special features include the punch and die ejectors, fitted with electrical safety devices so that in the event of a tooling failure the machine is stopped almost instantaneously by motor plug brakes working in conjunction with a powerful band brake. The machine is fully automatically lubricated and can be supplied with a variable speed drive.

Also available is a complete range of standard and high speed, single and double blow, open and solid die cold forging machines; reheading and trimming machines; thread rolling machines, etc.

Advice willingly given on any manufacturing problems connected with cold or hot forging.

GREENWOOD & BATLEY LTD.

ALBION WORKS LEEDS ENGLAND

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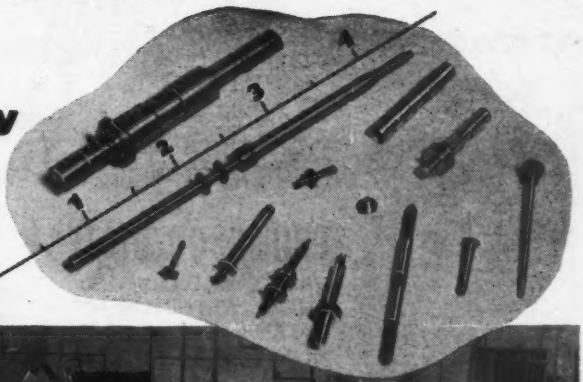
. . . for accuracy combined with large scale production



S. SMITH & SONS (ENGLAND) LTD.

use

TORNOS

***sliding head* Automatics**

Ideally suitable for the large scale production of high precision parts — both simple and complex — the TORNOS sliding head automatic with its many special features is unequalled for performance, precision and workmanship. Eight models are available with a stock capacity of 4 to 32 m.m., and details will gladly be sent on request.

TORNOS SALES COMPANY (E. M. VAUGHAN LTD.) 301 BROADGATE HOUSE, COVENTRY, Phone: 26815. Telex: TORNOS, COV. 31541

When answering advertisements kindly mention MACHINERY.

THOMPSON-DIATEST

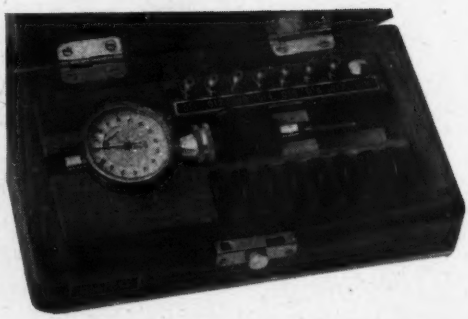
GAUGE WITH RIGHT-ANGLE ATTACHMENT
No. E100

Permits the checking of bores without removing the workpiece from the machine. Maximum space required between workpiece and tool is 1¼" plus length of measuring unit. Sideways movement of dial gauge can be extended as desired.

THOMPSON-DIATEST

GAUGE WITH UNIT DEPTH ADJUSTER
No. E107

The unit depth adjuster permits the checking of bores of any defined depth and is especially useful for checking large numbers of similar components. By the use of extension rods measuring depth can be adjusted to suit any needs.



THOMPSON-DIATEST

Electronic

BORE GAUGES

THOMPSON-DIATEST units in conjunction with electronic gauges for the basis of a complete bore gauging system. Our advice on your own gauging problems is fully and freely available.

THOMPSON-DIATEST

Complete Sets . . .

A range of nine standard sets in English or metric arranged in various combinations. A separate leaflet is available giving complete details of these sets which cover all needs from 0.038" up to 1.610" dia. (1 mm. — 40 mm.)

Write for full details of all THOMPSON-DIATEST accessories available . . . to the sole importers :

MICHAEL S. THOMPSON LTD.

TELEPHONE : RIVERSIDE 7922/3

THOMPSON-DIATEST

High Precision

SMALL BORE GAUGES

. . . . . a complete range of equipment to solve your checking problems

NO MORE TROUBLE GAUGING . . .

. . . blind bores, tapered bores, incomplete bores, barrel shaped bores, out-of round bores, where other bores interfere.

★ THOMPSON-DIATEST gauges can be operated by unskilled labour.

★ THOMPSON-DIATEST unit heads are hard chromium plated to withstand wear or can be supplied in tungsten carbide.

★ Simple adaptor converts the THOMPSON-DIATEST into an electronic bore comparator in conjunction with the MAGNA-GAGE or PARNUM.

★ Range 0.038" to 1.610" (1mm. - 40 mm.)

All Parts Interchangeable

185/187 HAMMERSMITH ROAD, LONDON, W.6.

TELEGRAMS: TOMTOOL, LONDON W.6

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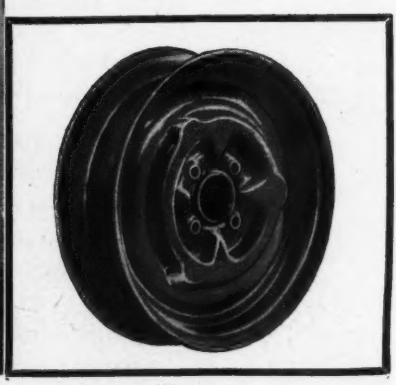
AJAX AJ4 RADIAL

Photographs: courtesy of Joseph Sankey & Sons Ltd, Wellington

MAINTAINS PRODUCTION AT Sankey OF WELLINGTON

This famous firm makes more vehicle wheels than any other manufacturer in Europe or the Commonwealth:—about 20,000 a day. The AJAX Radial in their maintenance shop is used to machine a wide variety of jobs on presses and rim rolling machines, thus assisting considerably in constantly maintaining this high rate of production—another example of AJAX *versatility* and *dependability*.



BRIEF SPECIFICATION

- 3" drilling capacity in steel
- 4' 6"; 5' 0"; 5' 6" arm
- Spindle No. 5 M.T.
- Rotary gear speed change
- Choice of three speed ranges
- Coolant equipment as standard

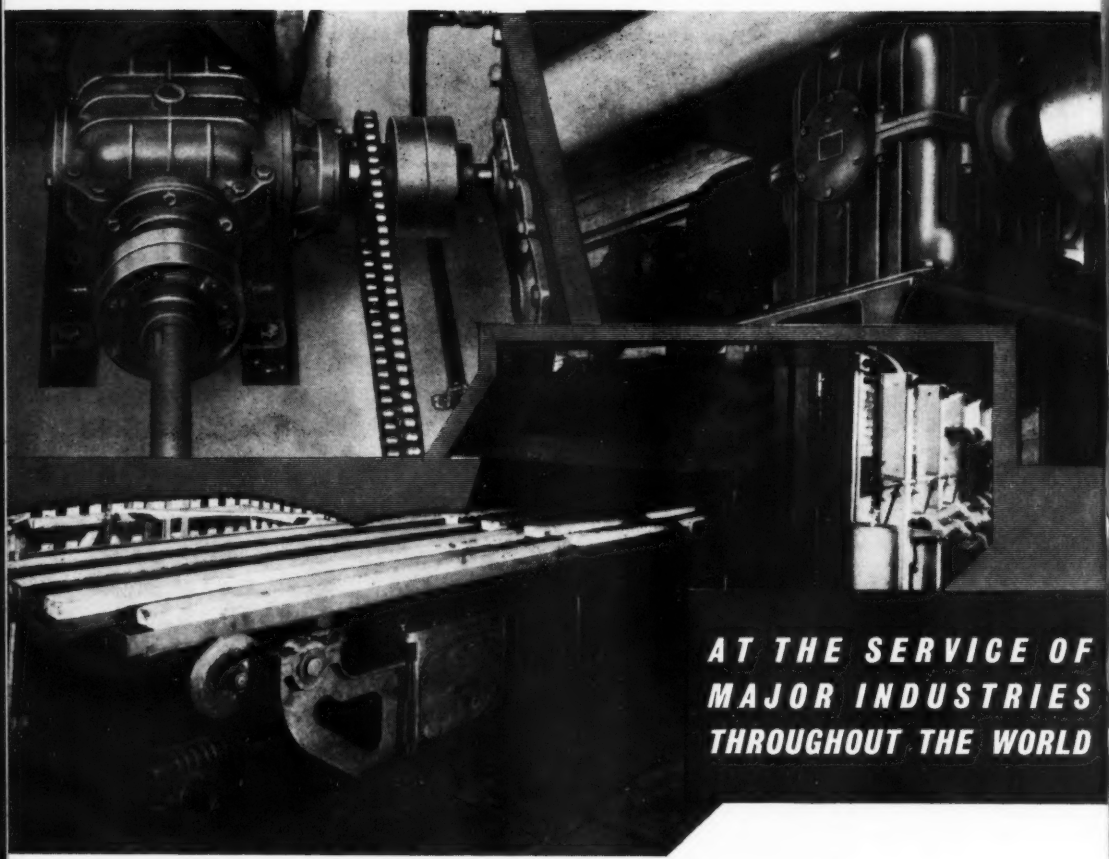
WE MAKE A COMPREHENSIVE RANGE OF MACHINE TOOLS DESIGNED FOR ACCURATE OPERATION AND TROUBLE-FREE SERVICE. INVESTIGATE HOW THEY CAN CUT YOUR MACHINING COSTS!

WRITE TODAY FOR BROCHURE AND NAME OF NEAREST STOCKIST

AJAX MACHINE TOOL COMPANY LTD
WEST MOUNT WORKS, HALIFAX, YORKSHIRE, ENGLAND
Telephone: 5395/9 Telegrams: Ajax, Halifax

Crofts

"RADIATION" SPIRAL BEVEL GEAR UNITS



AT THE SERVICE OF MAJOR INDUSTRIES THROUGHOUT THE WORLD

Crofts 'Radiation' SPIRAL BEVEL GEAR UNITS

Please send without obligation....copy/copies of your publication 611.

Mr.....

Position.....

Company Address .....

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M

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UNION

horizontal boring machines

MODEL BFT. 125/1
5in. Dia. Spindle

TABLE TYPES	BFT.63	BFT.80	BFT.100	BFT.125
Dia. of Spindle	2¾in.	3¼in.	4in.	5in.
Max. traverse of Spindle	22¼in.	28in.	36in.	44¼in.
Max. distance Spindle to table	28in.	36in.	44¼in.	55in.
Max. dia. faced	25in.	32in.	48in.	55in.
Working surface of revolving table	36in. by 28in.	44¼in. by 36in.	50in. by 44¼in.	64in. by 56in.
Max. distance between Facing Head and Outer Support	5ft. 11in.	7ft. 5in.	9ft. 4in.	11ft. 10in.
Spindle Speeds	(18) 4–1400	(18) 2.8–1000	(18) 5–500	(18) 2–360
Facing Head Speeds	(12) 4–180	(12) 2.8–125	(12) 5–100	(12) 2–60

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WATTS WARRANTY
its your safeguard on
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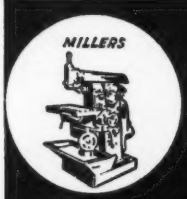


BRITISH AND CONTINENTAL MACHINE TOOL SOLE AGENTS AND DISTRIBUTORS.

WILLIAM WATTS LIMITED

CANAL STREET NOTTINGHAM TELEPHONE NOTTINGHAM 55502

Another

TWO-WAY DRILLING MACHINE

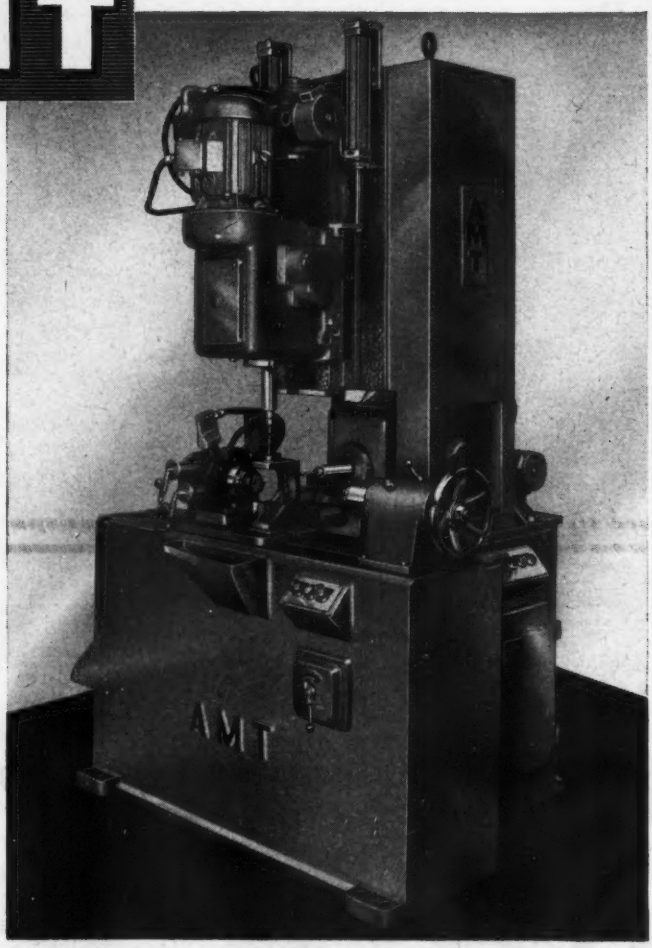
by AMT

incorporating

2 AMT/DI
2 h.p. UNIT HEADS

Fully automatic cycle giving 10 indexes, drilling 20 holes.

Machine recently installed at THE BRITISH PISTON RING CO. LTD., COVENTRY by whose kind permission this photograph is reproduced.



Operation:
20-$\frac{13}{32}$" dia. holes
Cycle time 2¼ minutes.

The range of AMT Drilling Heads comprises four sizes from 2 to 20 h.p. Brochure and full specifications will gladly be supplied on application.

A·M·T (B'HAM) LTD. BOURNBROOK, BIRMINGHAM 29
Telephone: SELly Oak 1128/9/20. Telegrams: AMTOLD B'ham

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MMT

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TO VISIT THE

MACHINE TOOL EXHIBITION

AT OUR EXTENDED SHOWROOMS

DECEMBER 11-15, 1961

A FULL RANGE OF MACHINE TOOLS DEMONSTRATED UNDER POWER

MORTIMER

EXCLUSIVE DISTRIBUTORS OF THE FINEST MACHINE TOOLS

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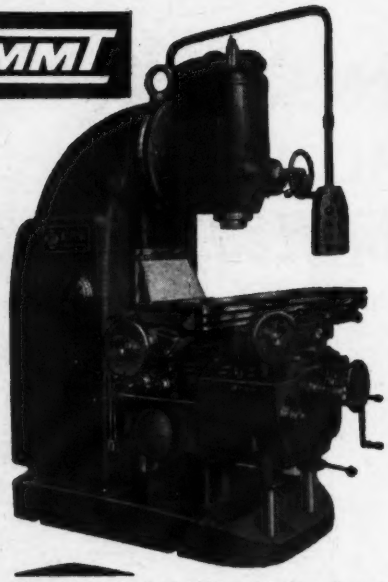


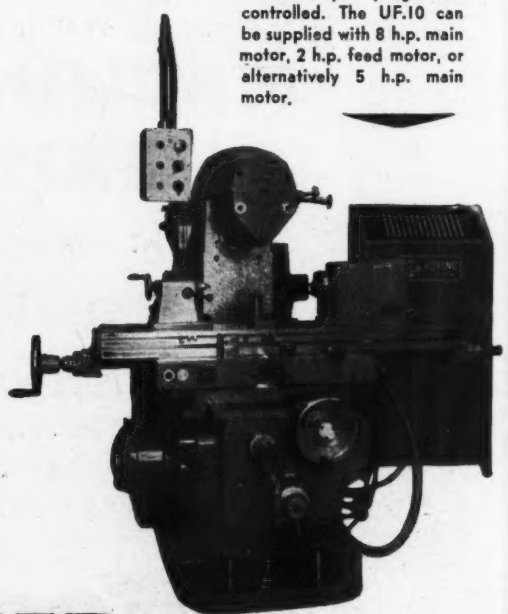
New VF.20 Vertical Milling Machine featuring the swivelling head with independent motor drive for power feed to quill, enabling power feed of quill to be obtained at any angle desired. This is a valuable feature especially in repetitive drilling and boring. Main spindle motor 15 h.p., feed motor 3½ h.p., special feed motor for spindle quill ½ h.p.

KÖPING

MILLING MACHINES

Lead the Field!

The UF.10 illustrated with automatic cycle programme control including rise and fall of knee and indexing. All machines supplied with double front support to knee giving maximum support under the heaviest cut. Range includes universal, plain, vertical, auto-cycle and auto-cycle programme controlled. The UF.10 can be supplied with 8 h.p. main motor, 2 h.p. feed motor, or alternatively 5 h.p. main motor.



Also world-renowned manufacturers of high precision heavy duty lathes, 45 models from 8" height of centres to 20" height of centres, 40" between centres to 120" between centres. Larger machines manufactured to special requirements.

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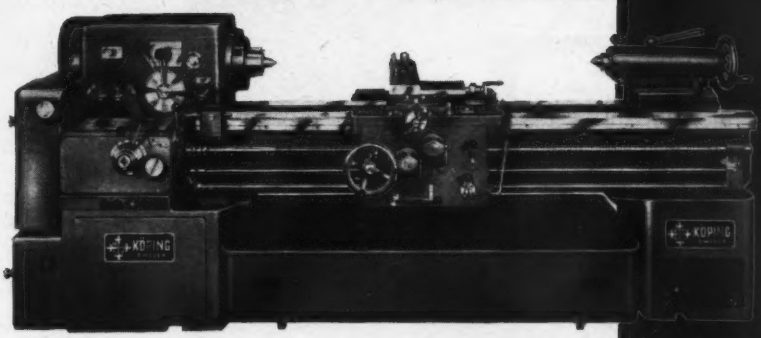
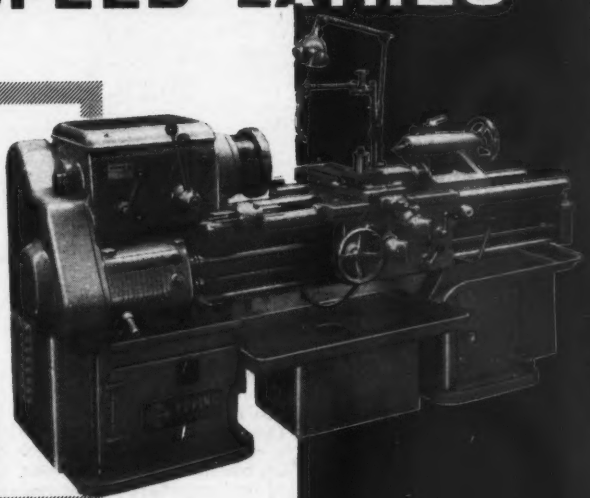


HIGH SPEED LATHES



S8C Model S8C High Speed High Precision Heavy Duty Lathe, 18 spindle speeds, 40 to 2,000 r.p.m. Frame hardened bed, totally enclosed feed box and apron, 20 h.p.

S8S Köping S8S High Speed Lathe, 18 spindle speeds 12.5 to 1,000 r.p.m. straight or gap bed. All Köping Lathes are of the highest quality built to last a life-time.

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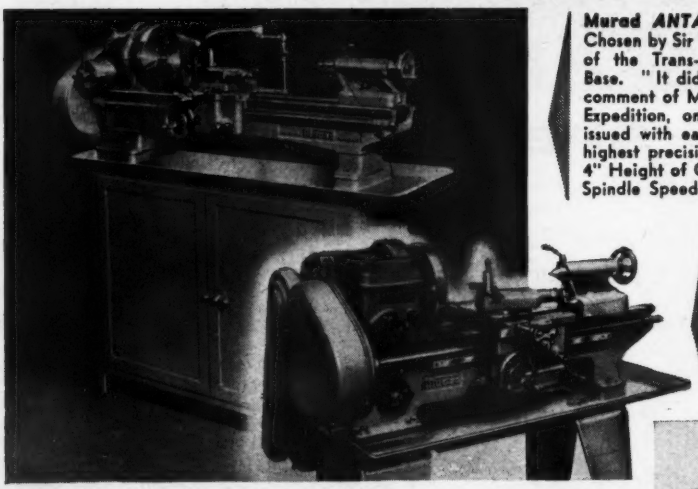
Murad

A GREAT NAME IN TURNING

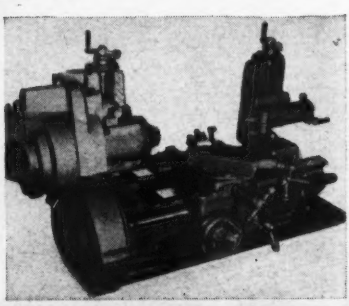


Murad *ANTARCTICA* Precision Lathe
Chosen by Sir Vivian Fuchs to service the equipment of the Trans-Antarctic Expedition at Shackleton Base. "It did everything we asked of it," was the comment of Mr David Pratt, Chief Engineer of the Expedition, on his return. A Test Certificate is issued with each machine showing it to be of the highest precision.
4" Height of Centres, 18" or 24" between Centres.
Spindle Speeds 40 - 1,600 r.p.m.

The Cadet
All geared head centre lathe. It was chosen for the R.N.Z.N. Ship "Endeavour" which serviced Sir Edmund Hillary's part of the Trans-Antarctic Expedition at Ross Bay.
4" Height of Centres, 18" or 24" between Centres.

Get the details of these well proven machines . . today

The Bormilathe
An outstandingly versatile machine, is an entirely new type of Machine Tool capable of carrying out boring, milling and turning and every type of wood-working. A Bormilathe is now on its way to the Arctic Region for the use of an Expedition by the Canadian Department of Northern Affairs and National Resources.
From Pole to Pole, men who direct great enterprises choose Murad.



MURAD · ASSOCIATE COMPANY · GROUP

MURAD DEVELOPMENTS LTD.

WHITEWAY · QUEENBOROUGH · ISLE OF SHEPPEY · KENT

Telephone: SHEERNESS 3084

NRP 9184

The World's most advanced capstan lathe

The latest MURAD capstans, successors to a well-proven range, embody many advanced developments counting towards better and faster production. Controls, for instance, are finger light and at the correct height for the operator making possible greater output every hour of every day without fatigue.

Write to-day for complete details of these unique machines.

FAVOURABLE DELIVERIES

MODEL 3Q (illustrated)

Max. Collet Capacity ...	⅜"
Spindle Nose to Face of Turret	12¼"
Swing Over Cross Slide	4½"
Swing Over Bed	11½"
Four Speed Ranges:	
'A'	350/4,800 r.p.m.
'B'	225/3,110 r.p.m.
'C'	150/1,940 r.p.m.
'D'	85/1,030 r.p.m.

MODEL 1 STANDARD

Max. Collet Capacity ...	1"
Spindle Nose to Face of Turret	12¼"
Swing Over Cross Slide	4½"
Swing Over Bed	11½"
Speed Range as for Model 3Q	

Please write for full technical details of the above and other models, including the 1A, 1B, VELOMATIC and 3C.

The Murad

UNEXCELLED THROUGHOUT THE WORLD FOR PRODUCTIVE CAPACITY, ACCURACY AND OPERATING CONVENIENCE

Write to-day for complete details.

MURAD DEVELOPMENTS LTD.

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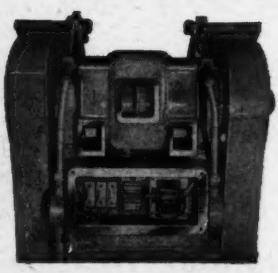
NRP 9183

THE NEW MURAD EG8 DUSTLESS GRINDER

- *Filter Resistance Halved*
- *Impeller Capacity Trebled*
- *Eye Shields and Local Lighting*
- *Now Standard*

These are some of the many improvements embodied in the new EG.8 making it without question the best off-hand Grinder in the world. The Murad Dustless Grinder is unique. It embodies its own dust inhibitor which offers protection to both worker and employer and makes the provision of a separate dust extraction plant unnecessary. It can be placed anywhere in the shop to suit the sequence of operations, even in close proximity to precision machines without endangering their slides. The repeat order is the finest tribute that a customer can pay to the efficiency and reliability of a machine tool. Britain's industrial giants have paid this tribute to the Murad Dustless Grinder.

Amongst many Users who send us a constant stream of repeat orders are such world-famous firms as Mullards, Pressed Steel, G.E.C., Atomic Energy Authority, A.E.I., British Oxygen, Gillette Industries, Skefko, etc., etc.



Control switchgear is designed into the machine and not added as an afterthought.

The above illustration shows the eyeshield swung up for ease in changing lamps, etc.

Pat. No. 674748

Murad DEVELOPMENTS LTD.

WHITEWAY · QUEENBOROUGH · ISLE OF SHEPPEY · KENT

Telephone: SHEERNESS 3084

NRP 9182

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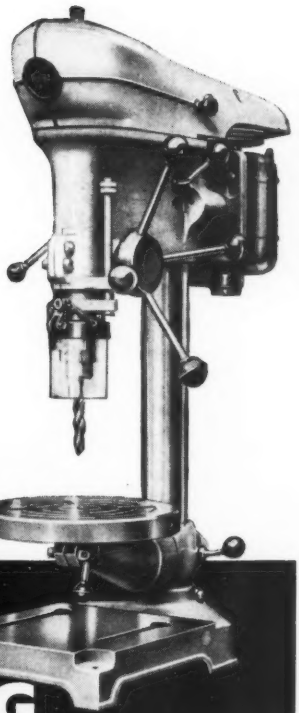
KERRY



KERRY ¾ INCH CAPACITY SUPER "8" SPEED DRILL

A production and general purpose jobbing machine, robustly constructed to ensure absolute reliability under the most arduous operating conditions. Features that have made this Super "8" so popular include a wide speed range — from 86 to 3,360 r.p.m. or 45 to 2,000 r.p.m. and adaptability for such applications as drilling, reaming, tapping, lapping, trepanning, etc. Tens of thousands are in use throughout industry today. The Super "8" is available as a bench, pedestal or line production model together with a complete selection of attachments for special application.

BENCH DRILLING MACHINES

THE KERRY "DRILLMASTER"

A ½ inch capacity production drilling machine designed for continuous operation over long periods. The "Drillmaster" can be supplied with a low, standard, or high speed range to suit customers' requirements. Each model has 4 spindle speeds ranging — in the low speed machine from 300 to 2,200 r.p.m. — the standard from 617 to 3,360 r.p.m., and the high speed machine up to 7,000 r.p.m. Bench, pillar and line production models are available in the above speed ranges.

KERRY'S

manufactured within the KERRY GROUP by
KERRY'S (Engineering) CO. LTD
GRANGE ROAD, LEYTON, LONDON, E.10

A Kerry COMPANY

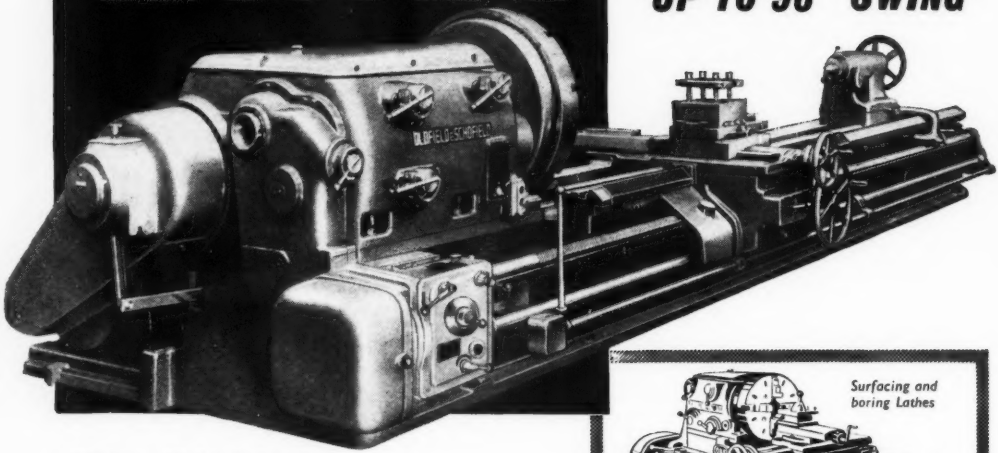
Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARyland 6611

C

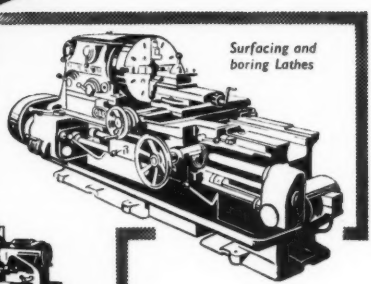
Heavy Duty LATHES

O & S

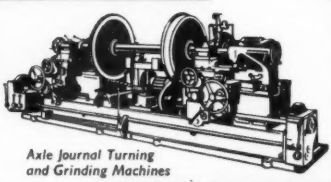
UP TO 96" SWING



18½" Centre 'D' Type Lathes. Built in sizes up to 48" swing.

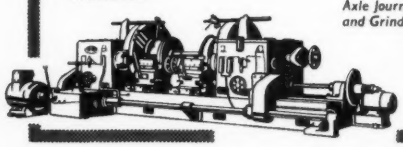


Surfacing and boring Lathes



Axle Journal Turning and Grinding Machines

Heavy Duty Double Wheel Lathe



O & S have for many years manufactured a wide variety of heavy lathes which have earned for the company a fine reputation for precision engineering and first class craftsmanship. The range includes Surfacing and Boring Lathes up to 96" swing, Brake Lathes, Axle Lathes, railway carriage and waggon wheel lathes, axle journal turning and burnishing lathes etc., all embodying the latest developments in modern lathe design.

O & S

manufactured within the KERRY GROUP by

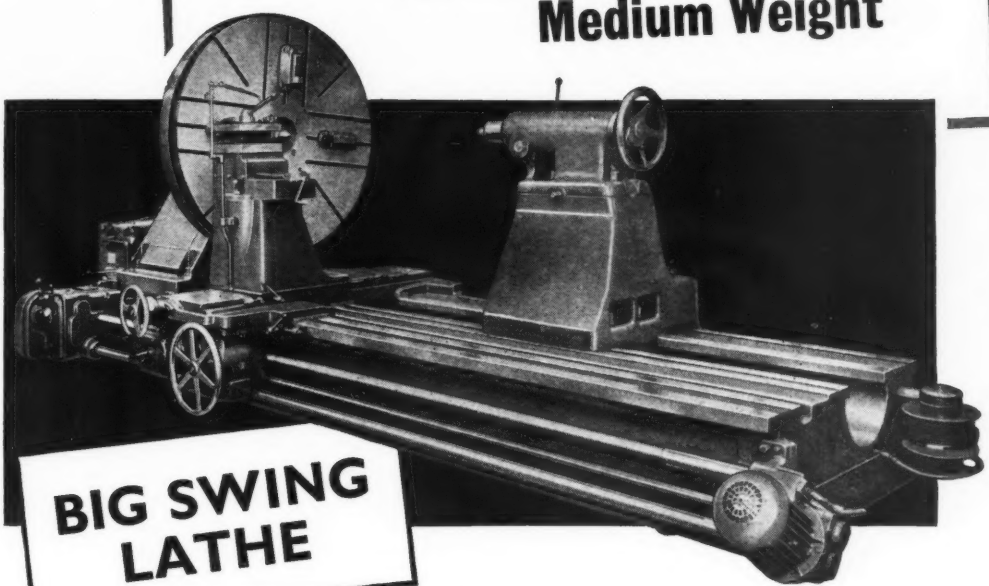
OLDFIELD & SCHOFIELD CO. LTD

BOOTHTOWN, HALIFAX, YORKSHIRE

A Kerry COMPANY

Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARyland 6611

For Turning LARGE Diameter Drums and Rollers of Medium Weight



BIG SWING LATHE

The O & S Range also includes:

SS & SC lathes from 10½ in. to 24 in. capacity; surfacing and boring lathes up to 96 in. swing; break lathes; railway carriage and wagon wheel lathes; axle journal turning and burnishing lathes; straightening presses.

This lathe will swing up to 6 ft. over the saddle and is specially designed for Turning Drums, Rollers, etc. It is easy to handle, economical in operation and competitively priced. The Big Swing also makes this an ideal machine for general maintenance work.

The O & S Big Swing Lathe incorporates all these features:

- Up to 6 ft. swing over saddle
- Up to 25 ft. between centres
- 12 spindle speeds
- Large hollow spindle
- Spindle bearings PB or Taper Roller
- 32 enclosed change feed and screw-cutting box
- Long lead cutting gear
- Quick power motion to saddle
- Power feed to compound top slide if required
- Power feed to loose headstock if required
- 30 or 35 H.P. motor drive

O S

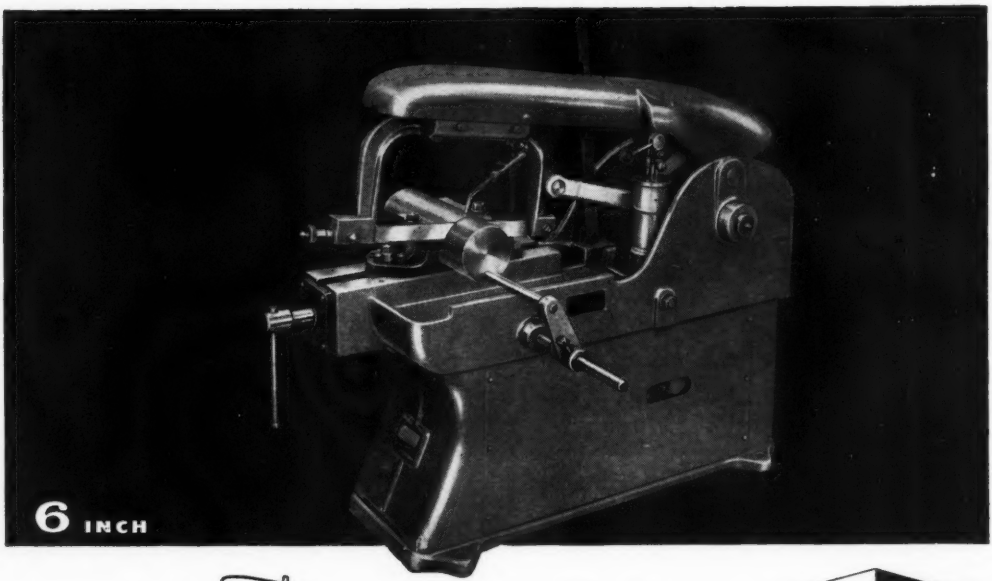
manufactured within the KERRY GROUP by

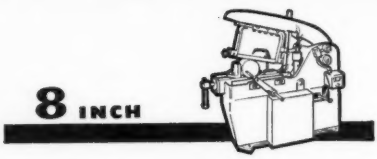
OLDFIELD & SCHOFIELD CO. LTD

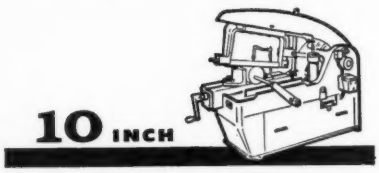
BOOTHTOWN, HALIFAX, YORKSHIRE

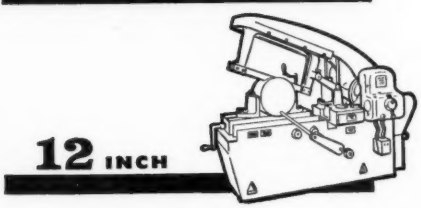
A Kerry COMPANY

Sales Office: WARTON ROAD, STRATFORD, LONDON, E.15. Telephone: MARyland 6611









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Modern in design, robust and precise in construction, these unrivalled machine saws cut accurately and rapidly, and offer maximum production efficiency. Refinements include totally enclosed drive, hydraulic relief on the return stroke and automatic lifting of the bowslide to loading position on completion of cut.

Instant lever selection of correct cutting speed is a feature of all but the smallest model.

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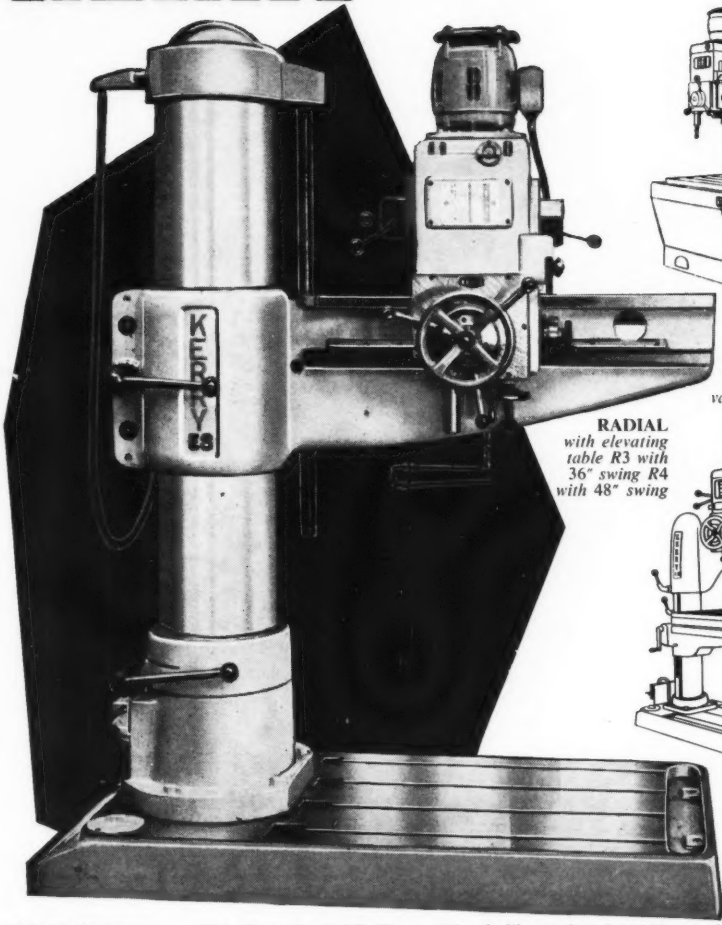
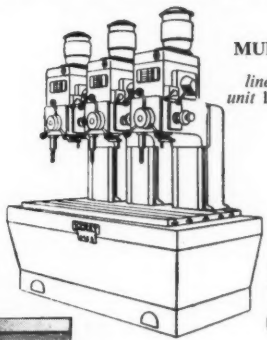
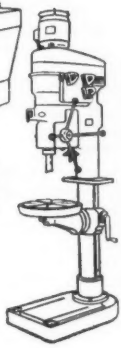
KERRY

RANGE OF DRILLING MACHINES



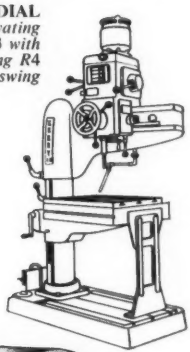


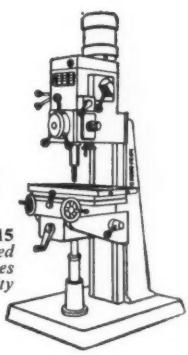
MULTI-HEAD MS 3
line production unit 1½″ capacity



TYPE 150 AG
all geared head also 150 IV infinitely variable 1½″ capacity

RADIAL
with elevating table R3 with 36″ swing R4 with 48″ swing





TYPE C15
three-speed ranges 1½″ capacity

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This Kerry Radial Drill type E (main illustration) is a 1½″ capacity machine with many fine features. The E3 has a 46″ swing and the E4, a 58″ swing, drilling 37″ and 49″ out from column base respectively. Both models have nine spindle speeds, quick hand traverse, fine hand feed and three rates of power feed. The massive 2 member-column solid base, and heavy rigid box section arm are all well ribbed to fully withstand stress. The wide Kerry range also includes bench, pillar and line production models.

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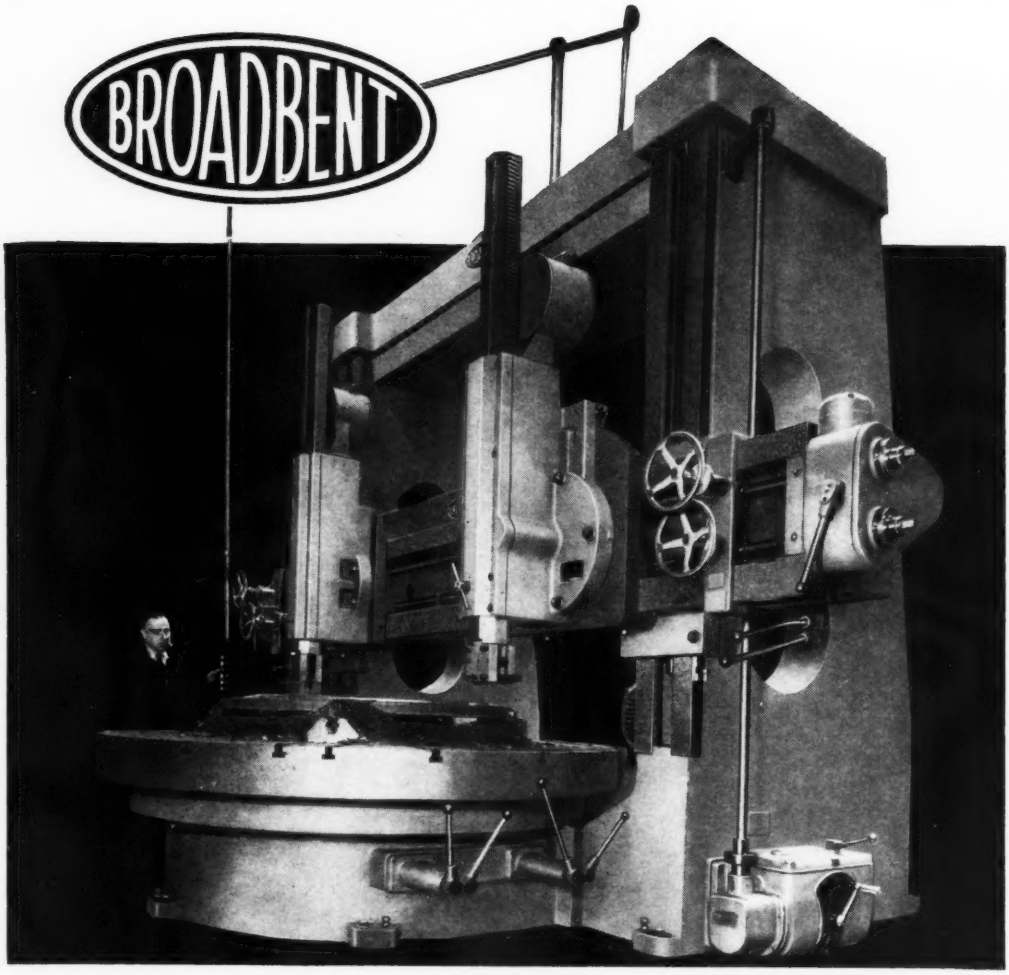
BROADBENT



HEAVY DUTY Vertical BORING & TURNING MILLS

with 5, 6, 8 or 10 ft diameter work tables

These incomparable machines are massively constructed for years of hard service. Accuracy and dependability are of the high order that industry has learned to expect of Broadbent Machine Tools. Notable features of these Boring and Turning Mills include twelve changes of speed and six changes of feed, controllable from either side of the machine; spiral bevel and spur reduction gears driving the work table; pendant control of rams and cross slides; and rapid power traverse with independent control of the two heads.

Please write for fully illustrated brochure.

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manufactured within the KERRY GROUP by

HENRY BROADBENT LIMITED

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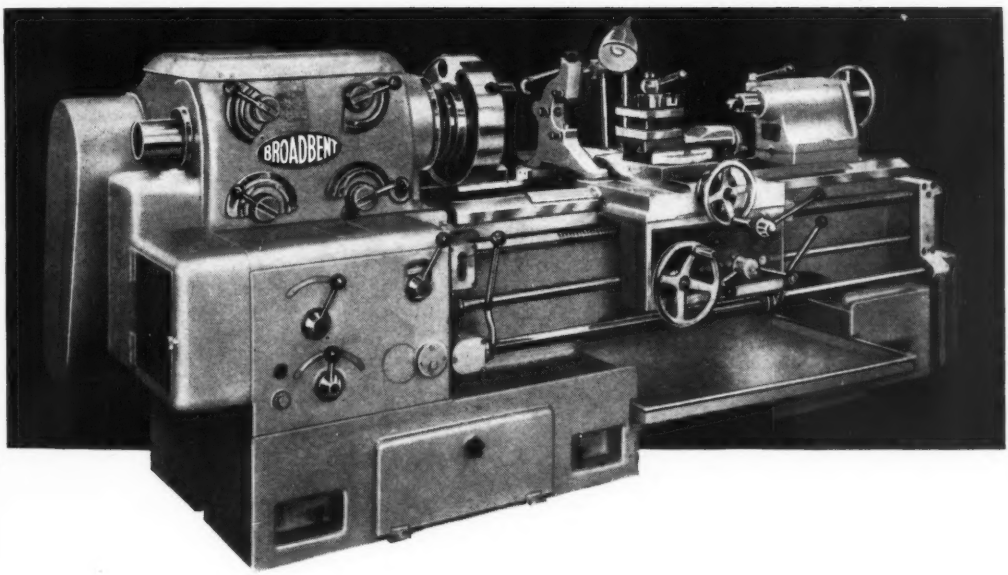
Broadway 4189

MORE output per man-hour with

BROADBENT

LATHES

Good men plus good tools equal good output. Every Broadbent lathe incorporates almost a century of machine tool building. Manufacturers know that for versatility, accuracy and reliability there is nothing quite as good as a Broadbent Machine Tool.



This 18/22″ Swing Heavy Duty Centre Lathe of modern design is a typical example of the Broadbent range. It has a 15 h.p. drive motor and spindle speeds up to 1,000 r.p.m.

The Broadbent range of Machine Tools includes Surfacing and Screw-cutting Lathes from 17″ to 72″ swing, Surfacing and Boring Lathes, Break Lathes, Crankshaft Lathes and vertical Turning and Boring Mills with 5′, 6′, 8′ or 10′ capacity.

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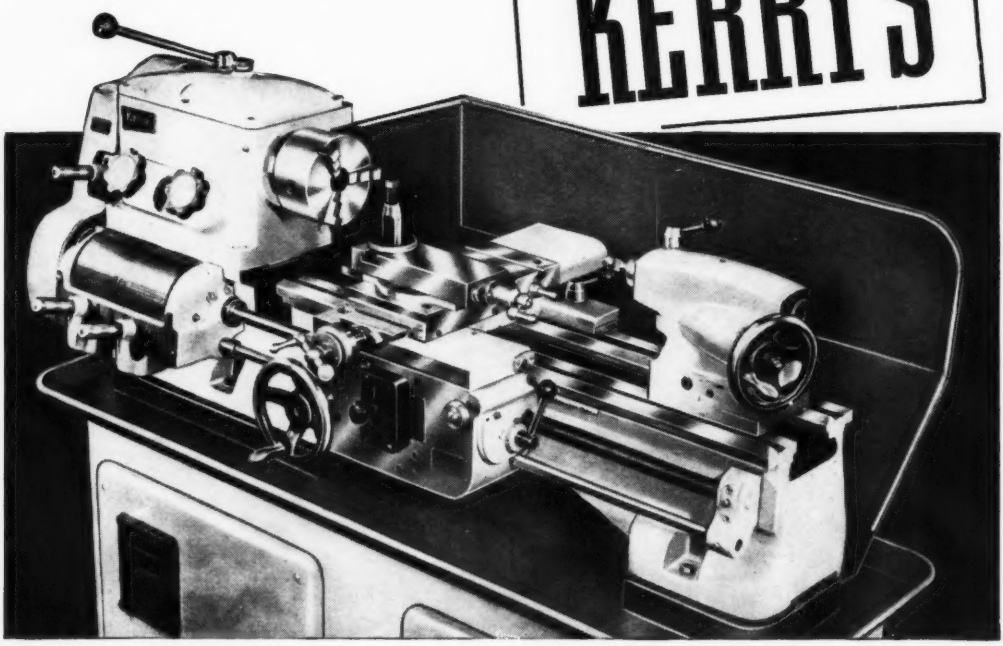

11" SWING LATHES

THOUSANDS in use in Great Britain and throughout the World!

★ SLIDING, SURFACING AND SCREWCUTTING LATHE

★ ALL GEARED HEADSTOCK GIVING 9 SPEEDS RANGING FROM 39-1500 r.p.m.

★ TYPE LOO PRECISION TAPERED SPINDLE NOSE

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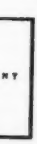

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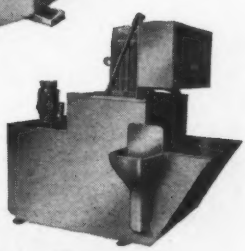


DE LAVAL TURBO-MATIC MINOR CLARIFIER Type WX 209-34

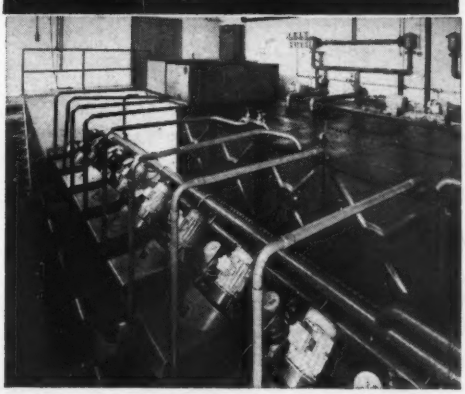
Completely automatic in operation and ensures uninterrupted flow of coolant

By the continuous removal of solids, De Laval Turbo-Matic Clarifiers ensure a coolant clarity unattainable by any other method.

The extracted solids, held in the large capacity bowl, are discharged automatically at pre-determined intervals.

De Laval Turbo-Matic Clarifiers can be used for individual requirements, or coupled up as a centralized installation.

NINE TURBO-MATIC clarifiers, automatically controlled by a timing device, installed by a large British bearing manufacturer for the centralized treatment of mineral oil.



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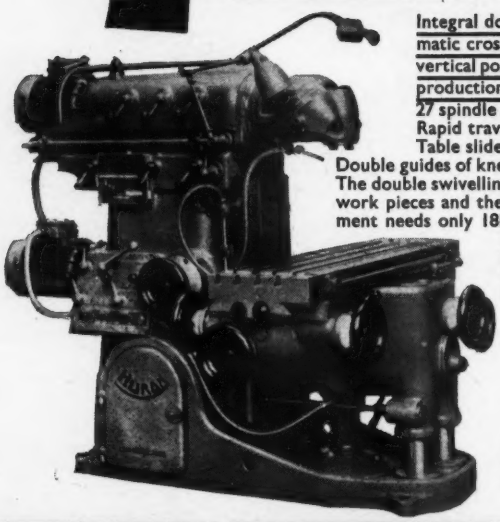
SLIDING RAM GIVES 27½in. AUTO CROSS FEED

HEAVY DUTY MILLING

ANGULAR COMPOUND HORIZONTAL VERTICAL

HURON SUPER UNIVERSAL MILLERS



Integral double swivelling universal head provided with 27½in. automatic cross feed by the sliding ram, can be set to the horizontal or vertical position, or to any angle instantaneously—permits the heaviest production cuts. Heads can be retracted completely from table line. 27 spindle speeds from 30 to 2,066 r.p.m., 27 feeds from $\frac{1}{16}$in. to 30in. Rapid traverses in all directions. All operating controls duplicated. Table slides directly in the knee without cross movement or swivel. Double guides of knee permit components in excess of 1½ tons to be machined. The double swivelling universal head requires an opening of only 14in. to enter work pieces and the whole sliding ram with its 27½in. automatic cross movement needs only 18in. clearance. OPTIONAL EXTRA FEATURES: Mounted spacing casting assemblies providing additional 8in. capacity under spindle. 26in. wide 8 T-slot tables and 39½in. automatic cross feed of sliding ram with special heavy duty knee and front operating position.

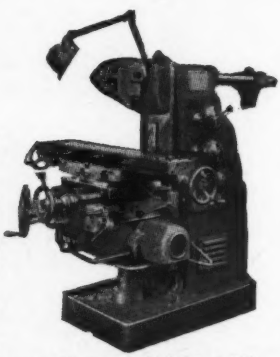
Type	Table	Automatic Feeds Long	Cross	Vert.
KU4	56½in. × 15½in.	43½in.	27½in.	19½in.
KU5	64½in. × 15½in.	51½in.	27½in.	19½in.
KU6	78½in. × 16½in.	59in.	27½in.	19½in.
KU55	64½in. × 26in.	51½in.	38½in.	18½in.
L83	157in. × 59in.	118in.	39½in.	59in.

HURON MU.6/FERRANTI 3-D MILLER

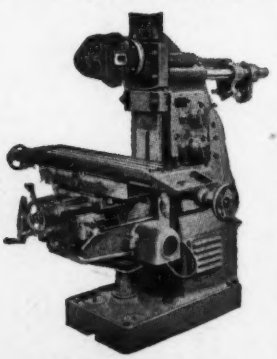
Type 'L' Open-side Traversing Head Universal Miller will mill, bore, slot and drill the largest work-pieces at one setting. The unique design permits greatest variety of operation on large work-pieces; the component remains stationary on the large work-table. Upright slides full length of base table and the sliding ram moves vertically and horizontally.

DUFOUR UNIVERSAL MILLERS

WITH DOUBLE UNIVERSAL SWIVELLING HEAD, RETRACTABLE SLIDE BRACKET AND SPACING CASTING GIVING 26" DAYLIGHT ON No. 59 AND 21" ON No. 61



FOR ALL MODELS Direct reading dial change for speeds and feeds. All parts subject to wear hardened and ground and completely interchangeable. Built to closest tolerances. Rapid traverses in all directions. Table swivels 30°. No. 40 taper for main horizontal spindle, double swivelling universal head, dividing head and rotary table. Hardened and ground centre guide for slideways. Twin overarms. Double swivelling sliding spindle heads with speeds 53-3000 r.p.m. Double swivelling universal head on retractable slide bracket providing with 5½in. Spacing Casting Drive assembly on 59 Machine 26in. daylight, and 21in. on No. 61.



MODELS 53 & 61. 16 universal head spindle speeds. 21-1600 r.p.m.; 8 horizontal spindle speeds 21-1180 r.p.m.; 8 automatic feeds ½-18½in.

MODEL 59. 36 universal head spindle speeds 14-1780 r.p.m.; 12 horizontal spindle speeds 21-1180 r.p.m.; 16 automatic feeds ½-20in.

MODEL 54. Automatic cross feed of universal head 20in.; 18 universal head spindle speeds 12-1500 r.p.m.; 36 horizontal spindle speeds 6-1500 r.p.m.; 18 automatic feeds $\frac{1}{16}$-23½in.

Type	Table	Automatic Feeds Long.	Cross	Vert.
53	43½in. × 9½in.	27½in.	9½in.	15½in.
61	47½in. × 10½in.	30½in.	9½in.	15½in.
59	51½in. × 11½in.	34½in.	11½in.	21½in.
54	67in. × 14½in.	43½in.	14½in.	20½in.

Send for full particulars of our very extensive range of these machines; ask for demonstration.

Rudolph Carne & Co. Ltd. SWAN WORKS, FISHERS LANE, CHISWICK, LONDON, W.4.

Tel. CHISWICK 0514, 6585 & 0337. Inland Telegrams: RUDCAR, CHISK, LONDON. Overseas Telegrams: RUDCAR, LONDON, W.4

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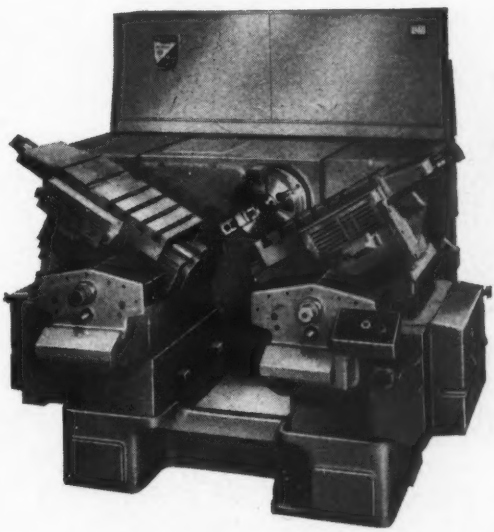
Front-operated multi-tool chucking lathes

The latest development of a remarkably efficient lathe design: Ideally suited to small, medium or large batch production the FRONTOR machines offer marked advantages in both setting and operating and require a minimum of floor area.

Available with

- Semi-auto cycle
- Transfer equipment
- Constant feed facing
- Auto-cycle with magazine feed
- Copying attachments
- Automatic chip disposal



FRONTOR machines are a joint development of two leading German machine tool manufacturers:

J. G. Weisser Söhne

FRONTOR 25

Nominal turning diameter: 9¾ in.

Maschinenfabrik Diedesheim

FRONTOR 40

Nominal turning diameter: 15¾ in.

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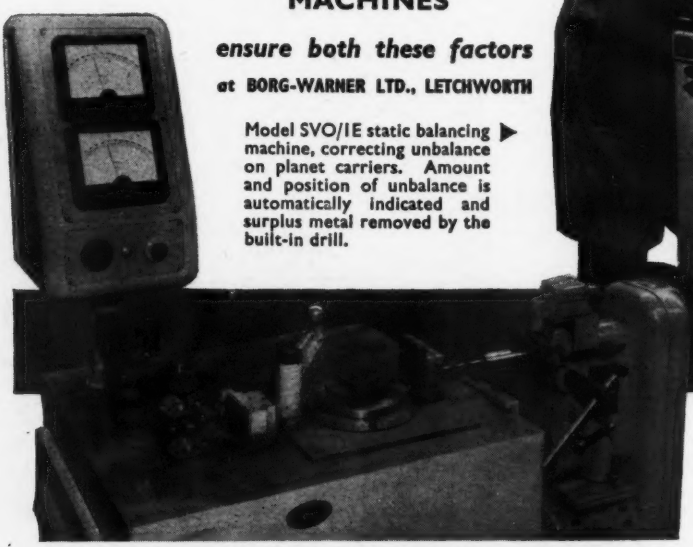
"EXACT BALANCE — OR CONTROLLED UNBALANCE"

JACKSON-BRADWELL

STATIC BALANCING MACHINES

ensure both these factors

at BORG-WARNER LTD., LETCHWORTH



Model SVO/1E static balancing machine, correcting unbalance on planet carriers. Amount and position of unbalance is automatically indicated and surplus metal removed by the built-in drill. ▶

◀ This Model SVO/E machine is used to ensure ACCURATE PREDETERMINED UNBALANCE on governors so that when a valve is subsequently fitted the balance of the assembly is restored.

There are JACKSON-BRADWELL machines for every duty to handle components and assemblies from the smallest to the largest sizes. There is a machine well suited to your own needs. Ask us for details.

JACKSON & BRADWELL LIMITED., Grove House. Sutton New Road, Birmingham 23

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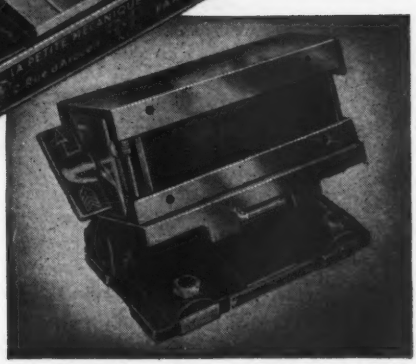
CLOSED DIMENSIONS
5" x 2½" x 1¾"

This latest addition to the Habit range of Sine tables provides a means of accurately locating angular work of small dimensions for inspection or grinding, jig boring, drilling and other machining operations.



The table is dimensioned to accept the Eclipse Double Sided Junior Magnetic Chuck.

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FRENCH **SAUT-DU-TARN**

VERTICAL SLIDING HEAD DRILLING, BORING, TAPPING AND MILLING MACHINE MODEL J 6c 320

This multi-purpose machine has an extensive selection of speeds and feeds plus an unusually wide range of traverses. Fast approach and automatic return of the spindle head, plus quick-change tool sockets, permit rapid operation. The head slides smoothly on rollers. The 35½" x 14¾" table has longitudinal and transverse automatic feeds, and when disengaged, the table floats freely on rollers for rapid hand positioning.

Capacities: 1¾" drilling, 4⅛" boring in medium C. steel.
Spindle speeds (12) 80 to 2750 r.p.m. Spindle head traverse 19⅝".
Table traverses: 15¾" long., 9¾" trans., 14¾" vertical.

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RG HIGH SPEED HYDRAULIC PRESSES

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5 ton bench and pedestal models. 10 and 15 ton models available with stroke limiting device (provides extremely accurate "inching"), T-slotted tables and automatic rotary indexing table.

	5 TON	10 TON	15 TON
STROKE	4"	8"	10"
TABLE SIZE	14" x 11¼"	16" x 14"	18" x 16"

Inspect these Presses at our Showrooms

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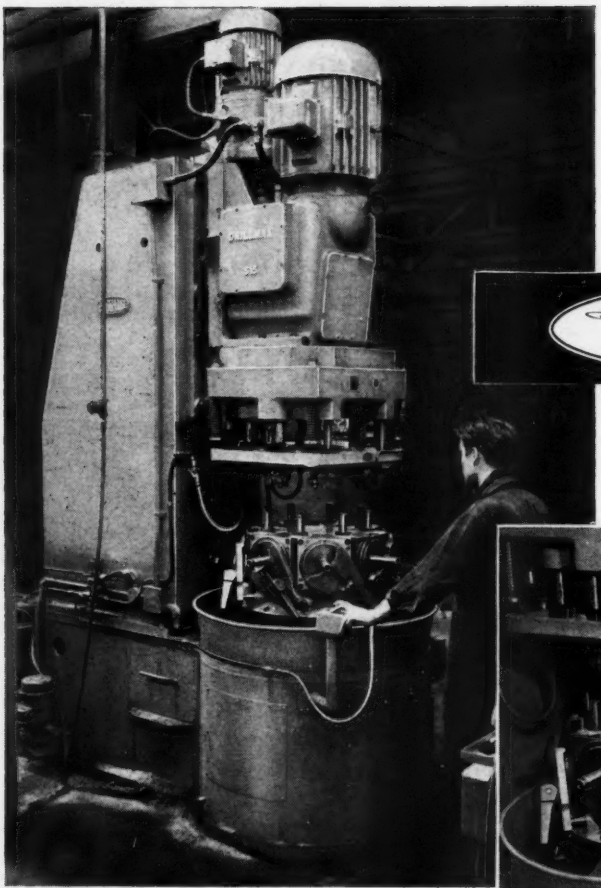
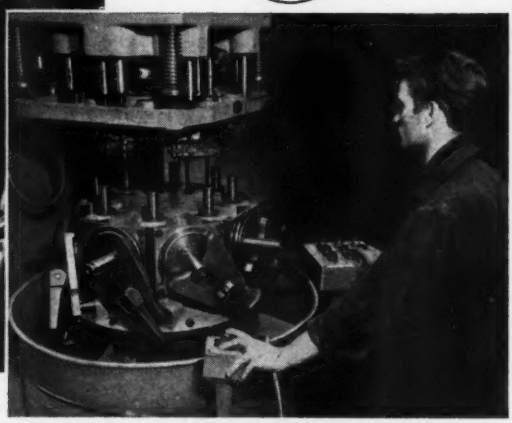
Making the NEW

BW Automatic 35 TRANSMISSION



Drillmax Machine illustrated is one of the several now in operation at the new £4,000,000 extension to the Borg-Warner Automotive Transmission factory at Letchworth, Herts.

Brasshouse DRILLMAX



Eight Station Rotary Index Machine for Drilling, Core Drilling, Recessing and Reaming various holes in malleable iron, pump adaptor.

Indexing tables are standard Drillmax equipment and can be supplied in conjunction with our range of standard Unit-Head and Multi-Head equipment.

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DRILLMAX DIVISION, LEIGHSWOOD ROAD, ALDRIDGE, STAFFS.

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-IN ONE OPERATION!

British-built MULTI-SLIDE MACHINES

One "U.S." Multi-Slide Machine has replaced as many as eight separate press operations on the production of a complex part. Two models are available which can be supplied completely tooled for the production of one or more components. If you manufacture formed stampings from material up to 3" wide the "U.S." Multi-Slide Machine offers outstanding reductions in production costs. Substantial material savings, less parts handling, less floor space, are only some of the benefits.
Send us samples or drawings of the stampings you are producing or considering and we will be pleased to submit a detailed quotation.

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TOOLROOM MILLING
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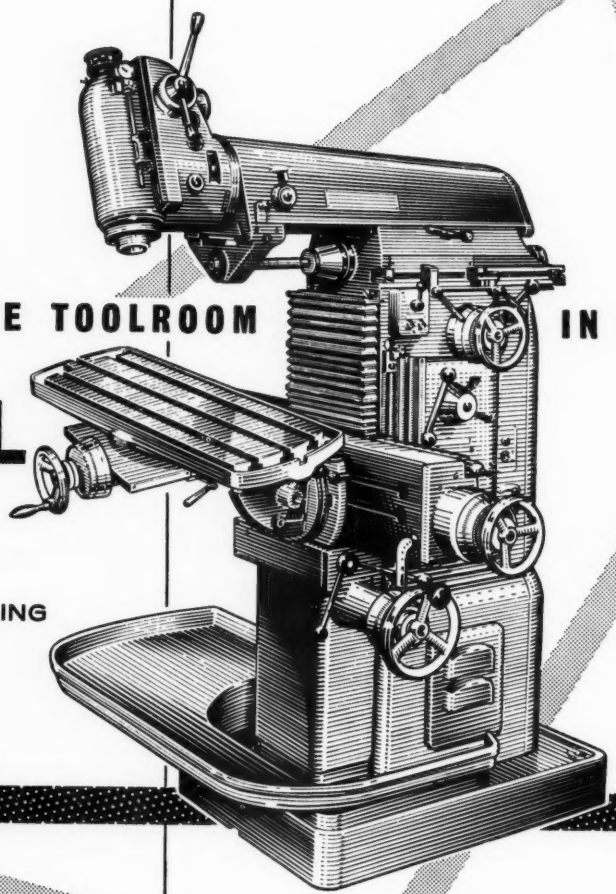

This well established machine, designed for sustained accuracy, extreme versatility, simple operation and long life, is one of the Thiel range of precision toolroom machines.

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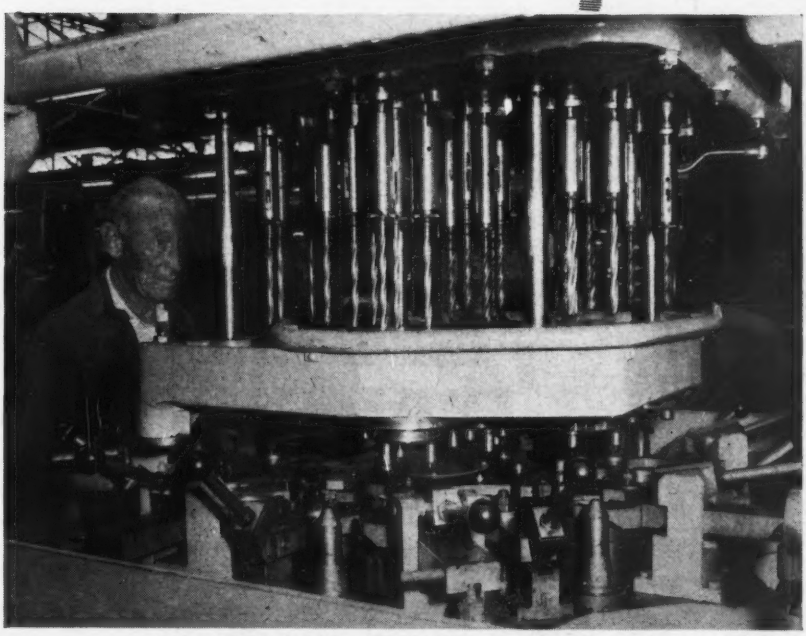

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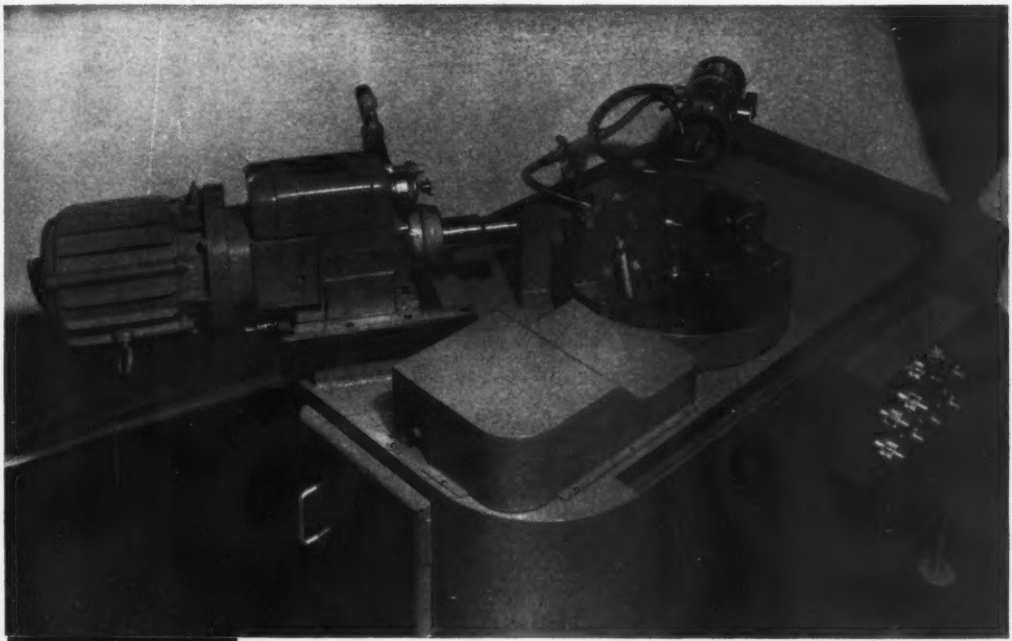

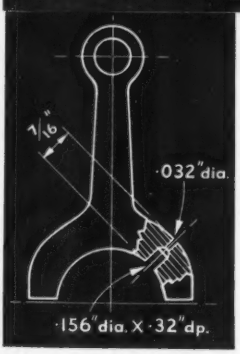

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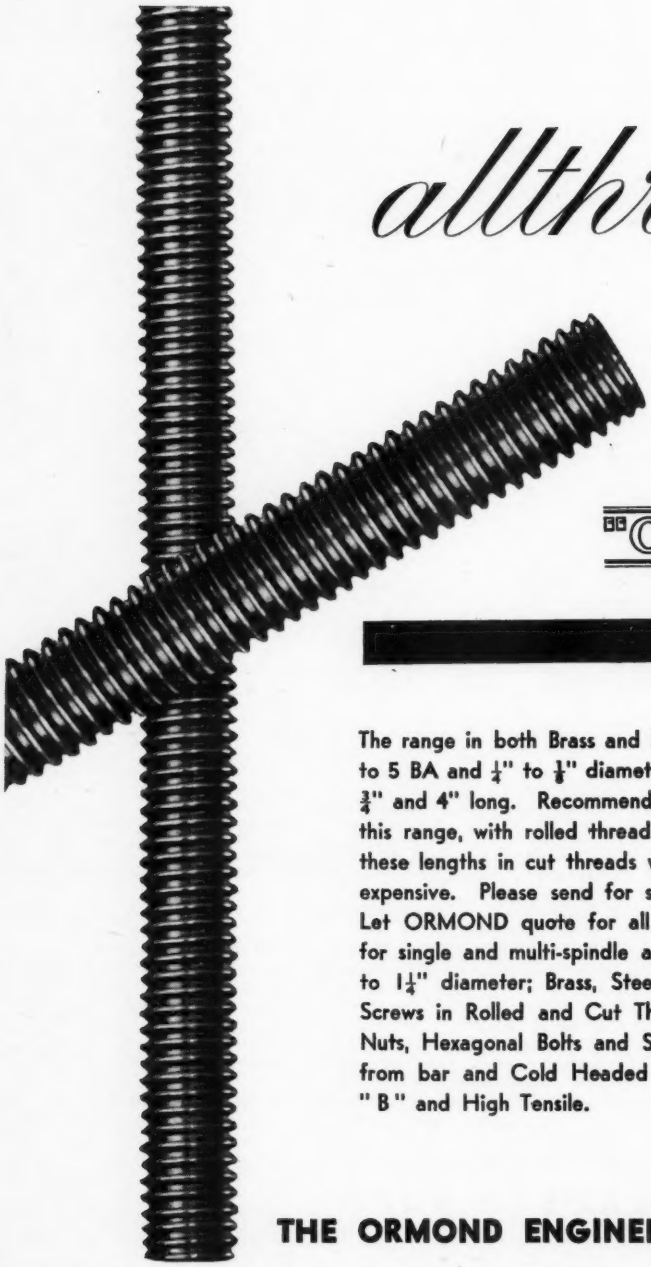

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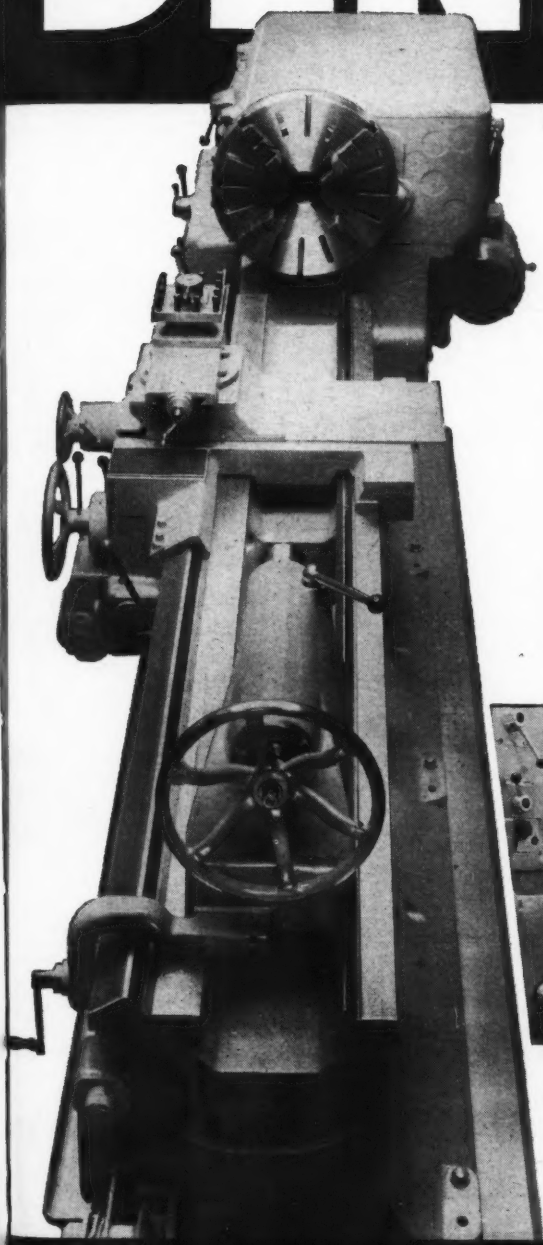

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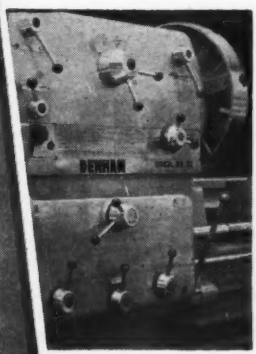

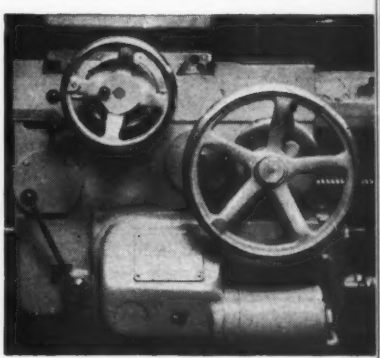

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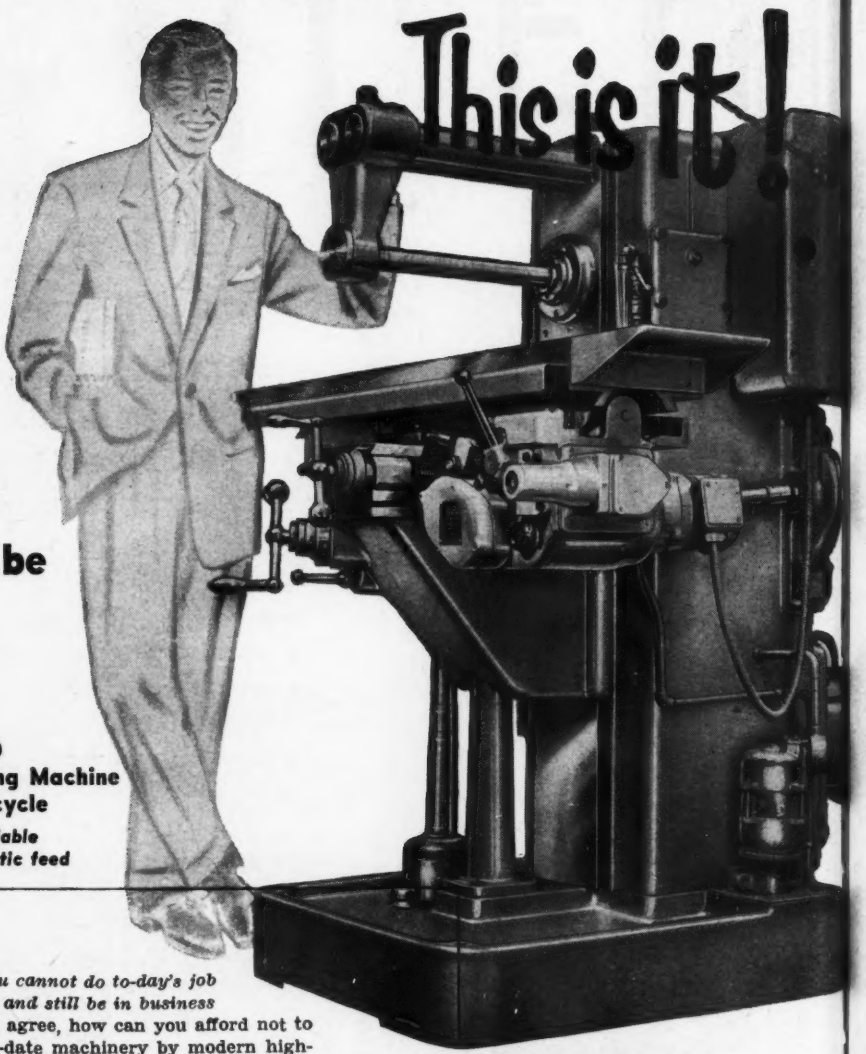

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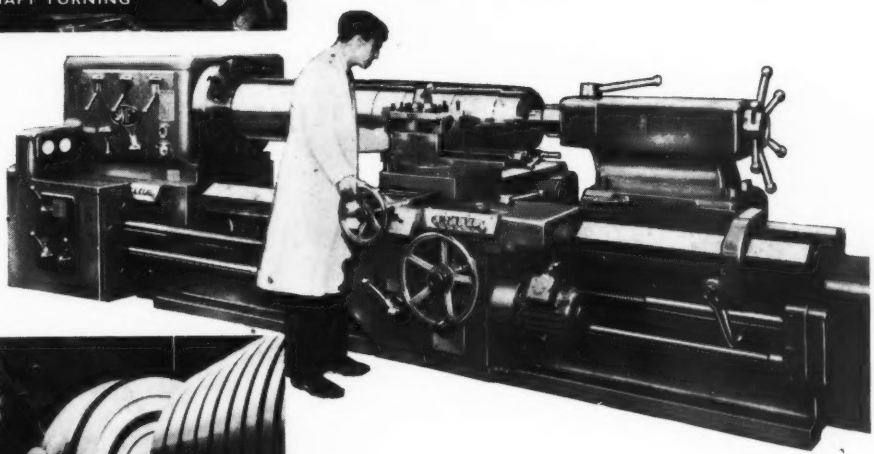

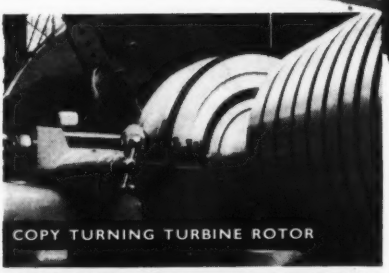
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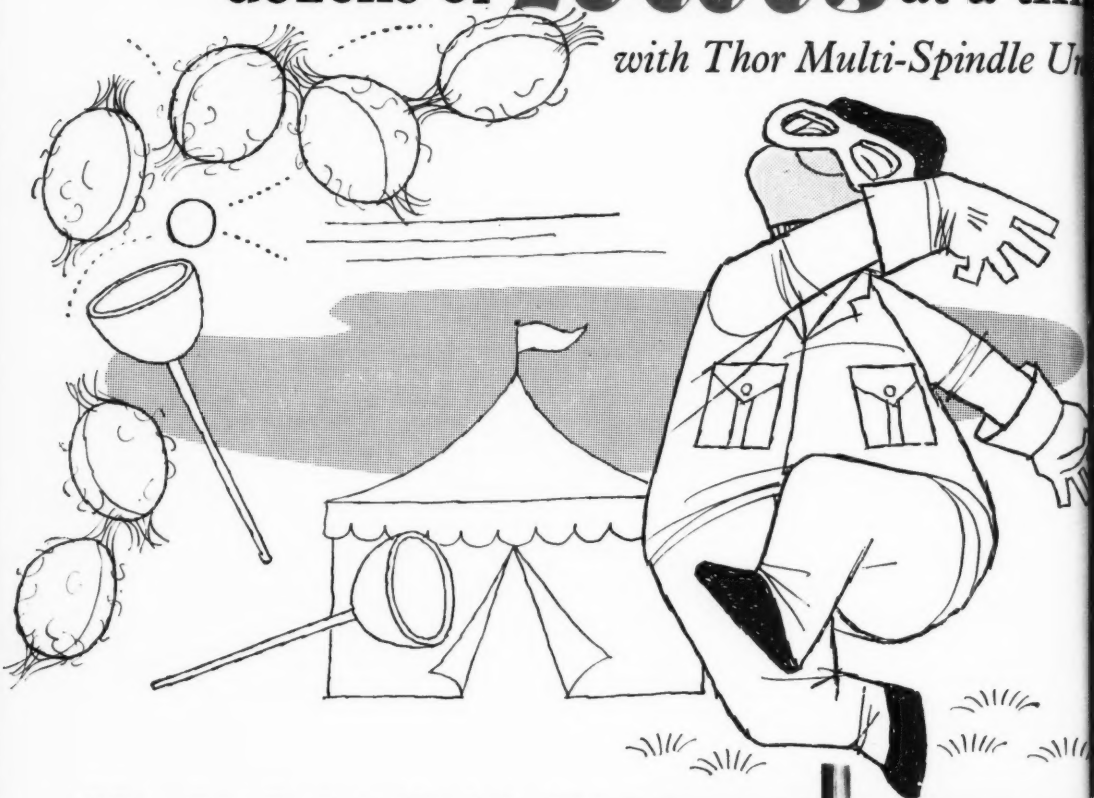

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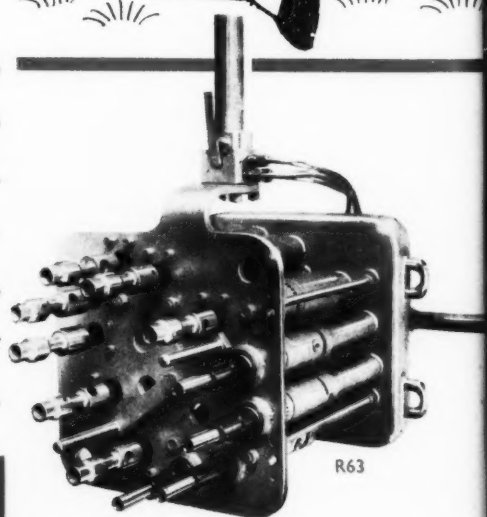

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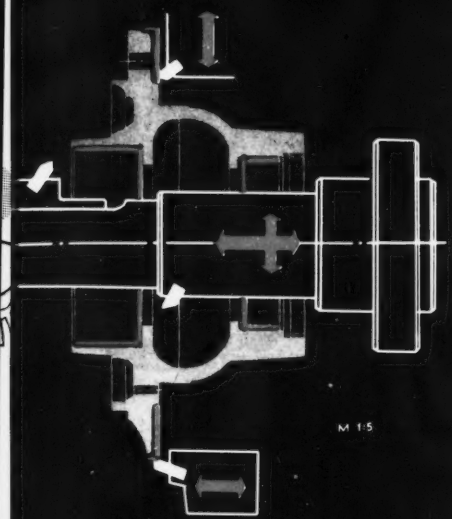

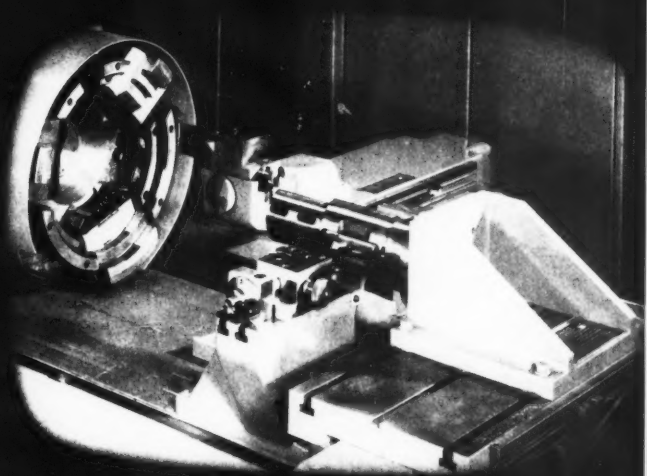

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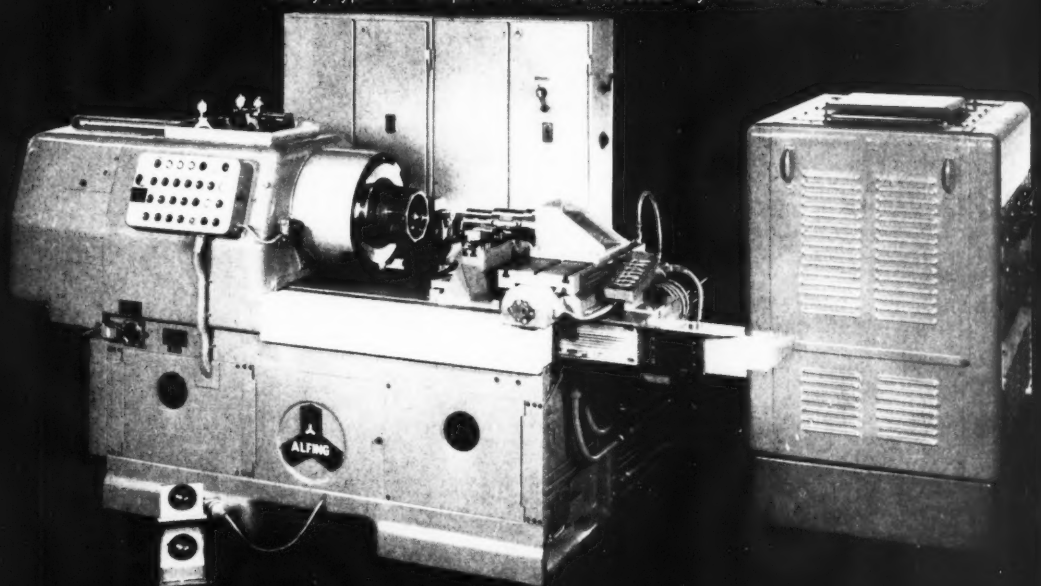

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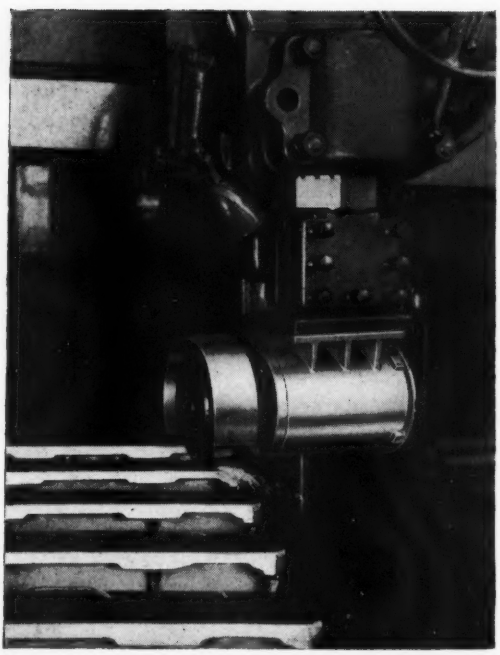
Snout extensions are available from 4½in. up to 24in.

This photograph shows a "WRIGHT" Motorised Grinding Spindle Type HRF/S, fitted to a Richards 18 feet Vertical Boring Mill. The Motorised Grinding Spindle develops 3 H.P. at 1,450 R.P.M., and has a 4½in. snout extension.



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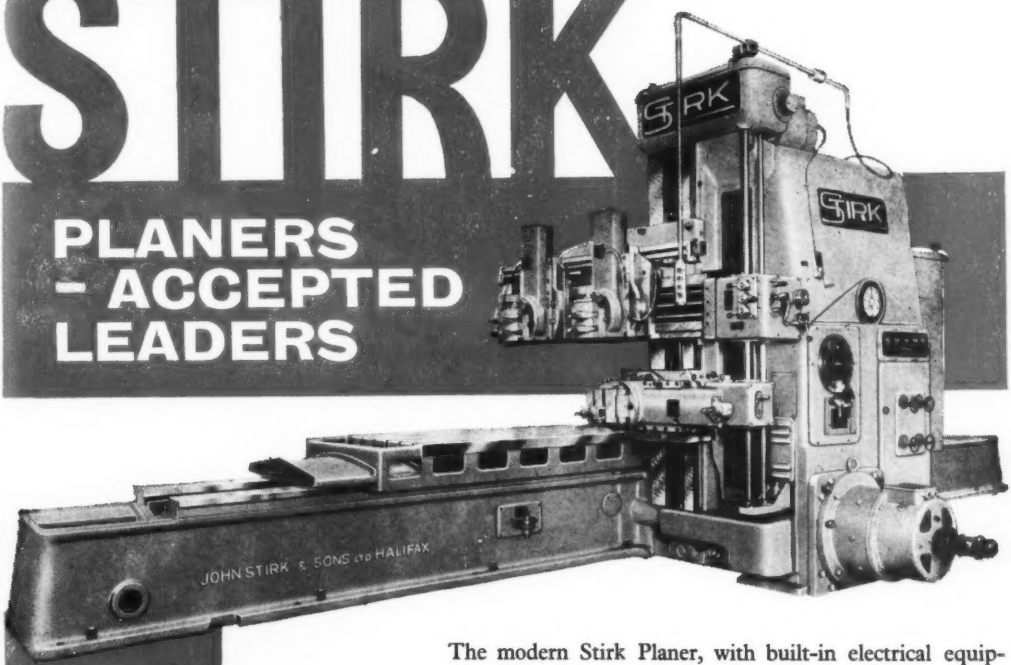

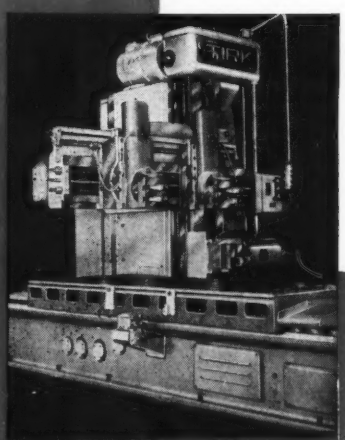

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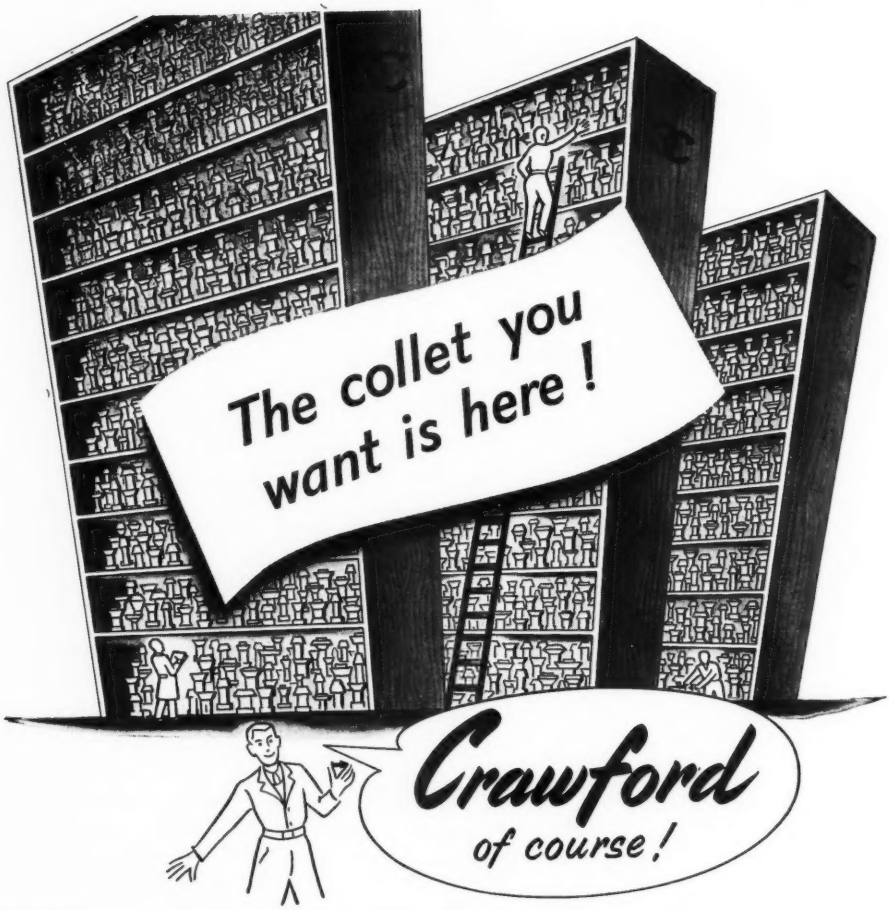

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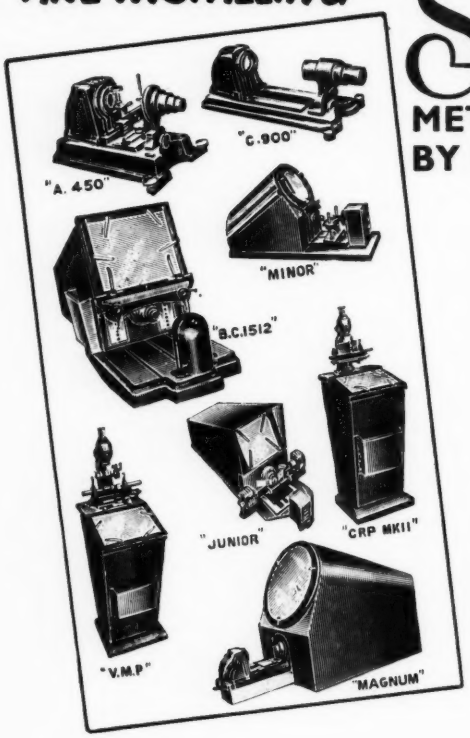

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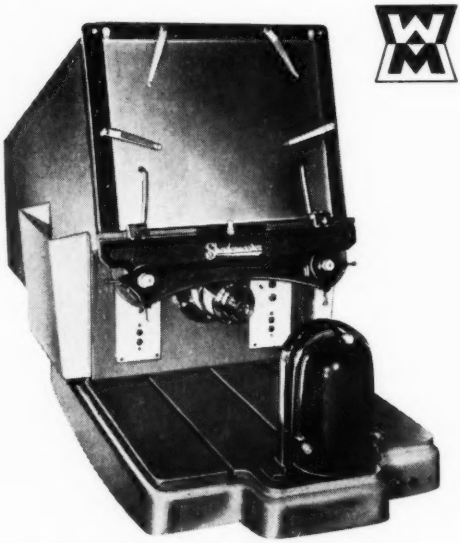

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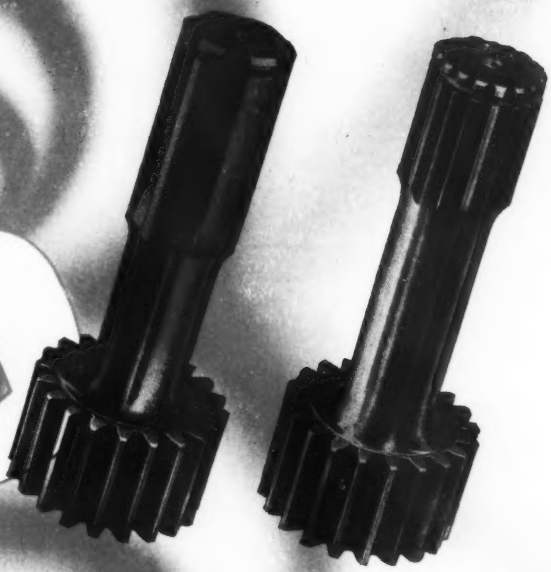

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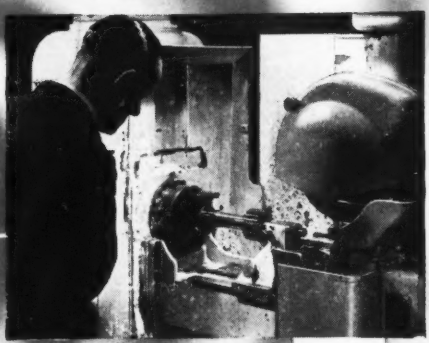

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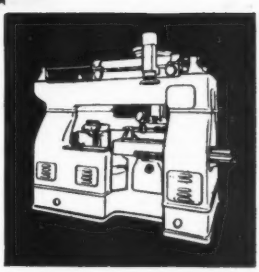

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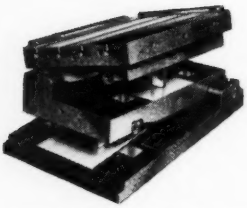
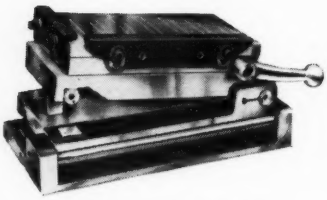
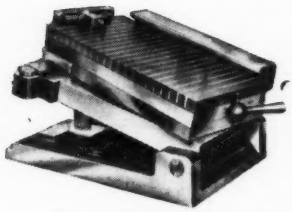


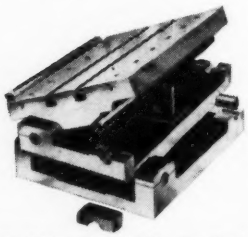
Compound Sine Table with 'T' Slotted Face: 12in. by 8in.



Compound Sine Table with Non-Electric Magnetic Face: 10in. by 5in.



Produced for Grinding Turbine Blades. Tilting and Swivelling with 14in. by 8in. Non-Electric Magnetic Chuck.



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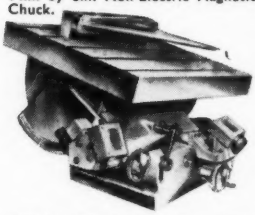

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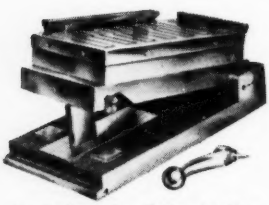
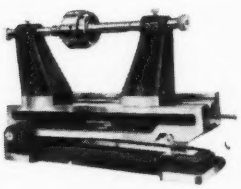


Simple Angle Sine Table with Non-Electric Magnetic Face: 10in. by 5in.



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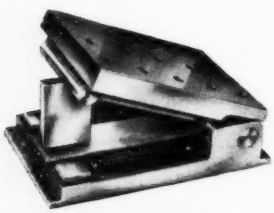

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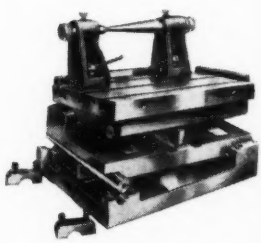

Universal Compound Sine Table with 'T' Slotted Face: 11in. by 7in.

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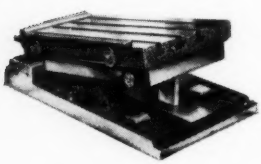

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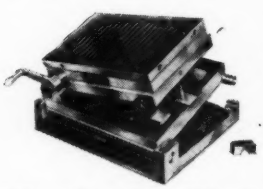

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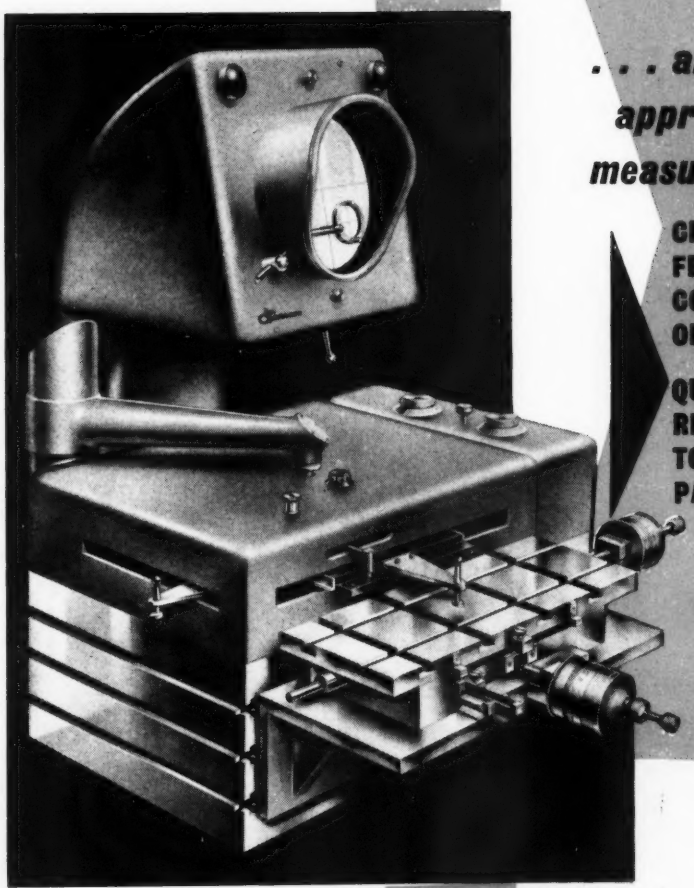

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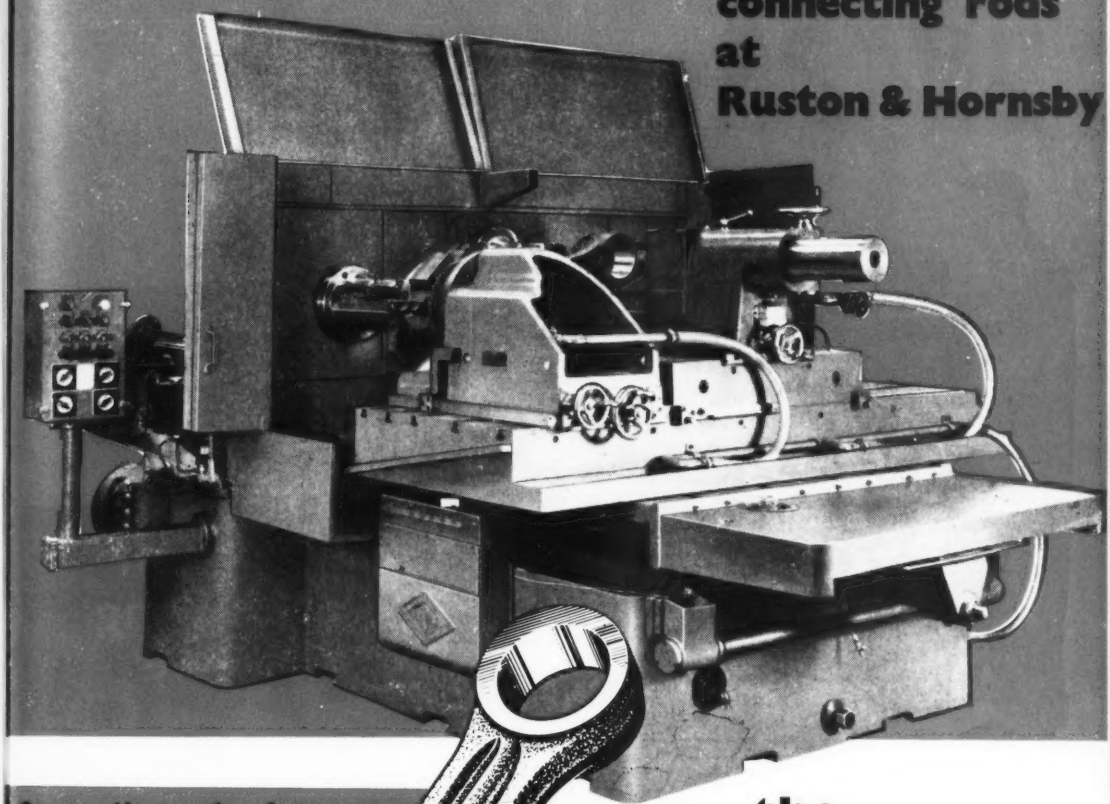

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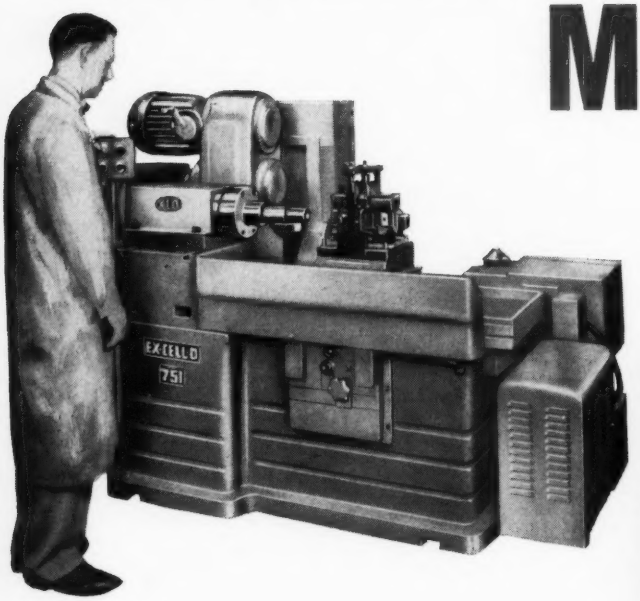

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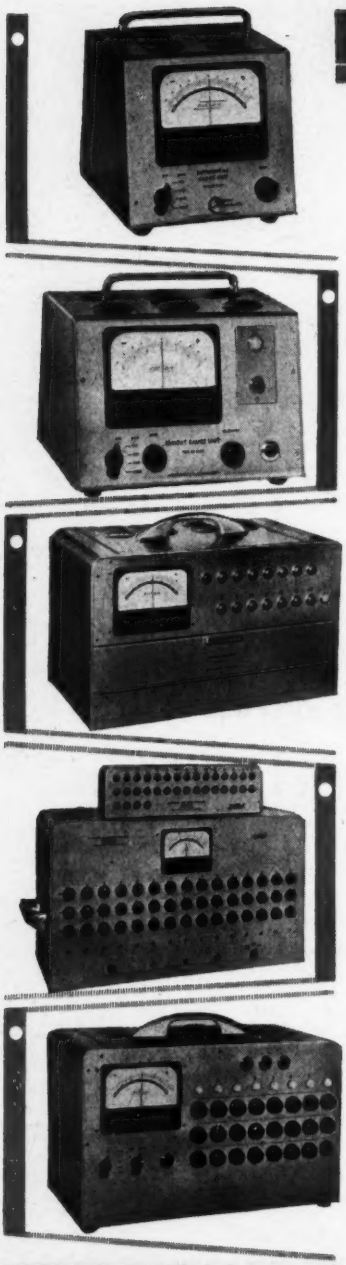

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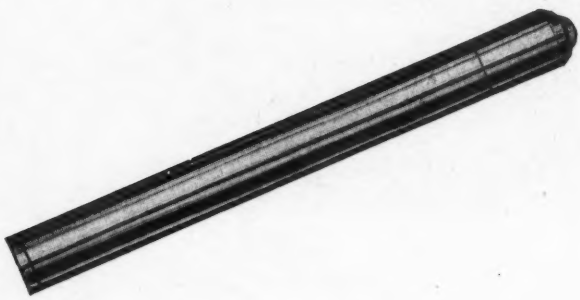

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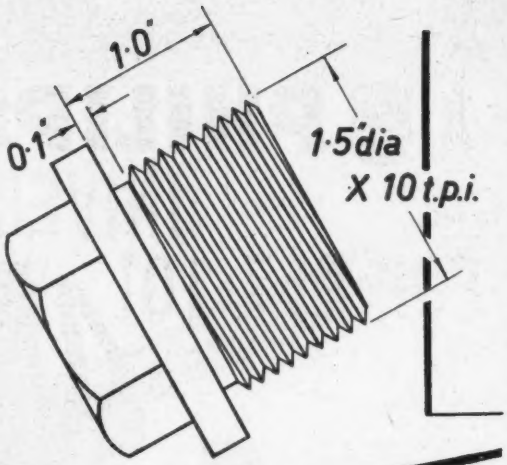

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For 1 off and upwards
Toolroom or Production — setting time is negligible.

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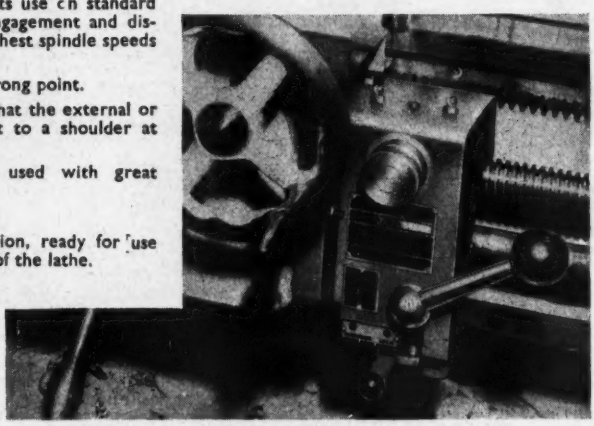

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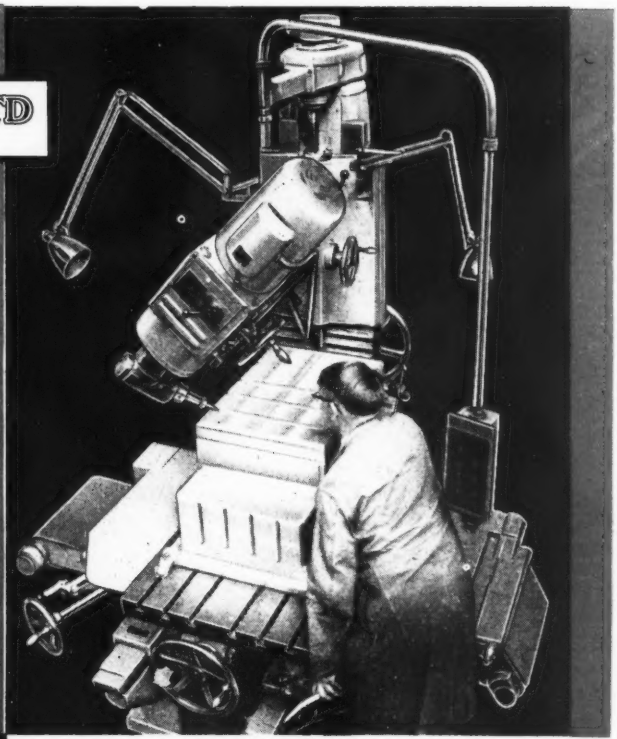
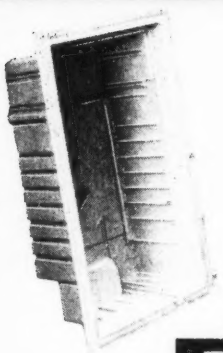


Bohner & Kohle

F2 UNIVERSAL HIGH SPEED MILLING MACHINES



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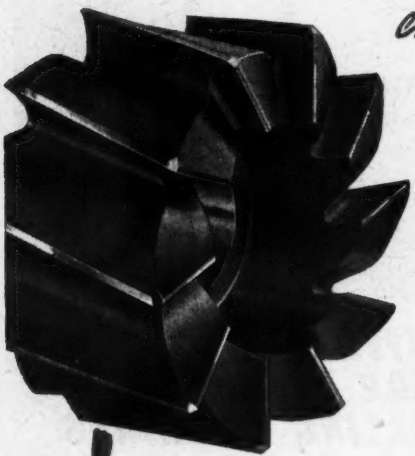

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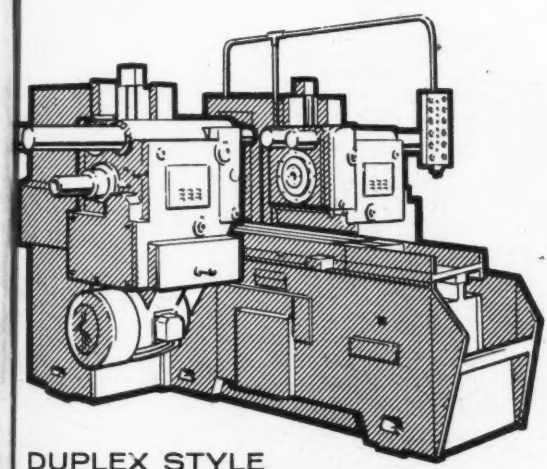

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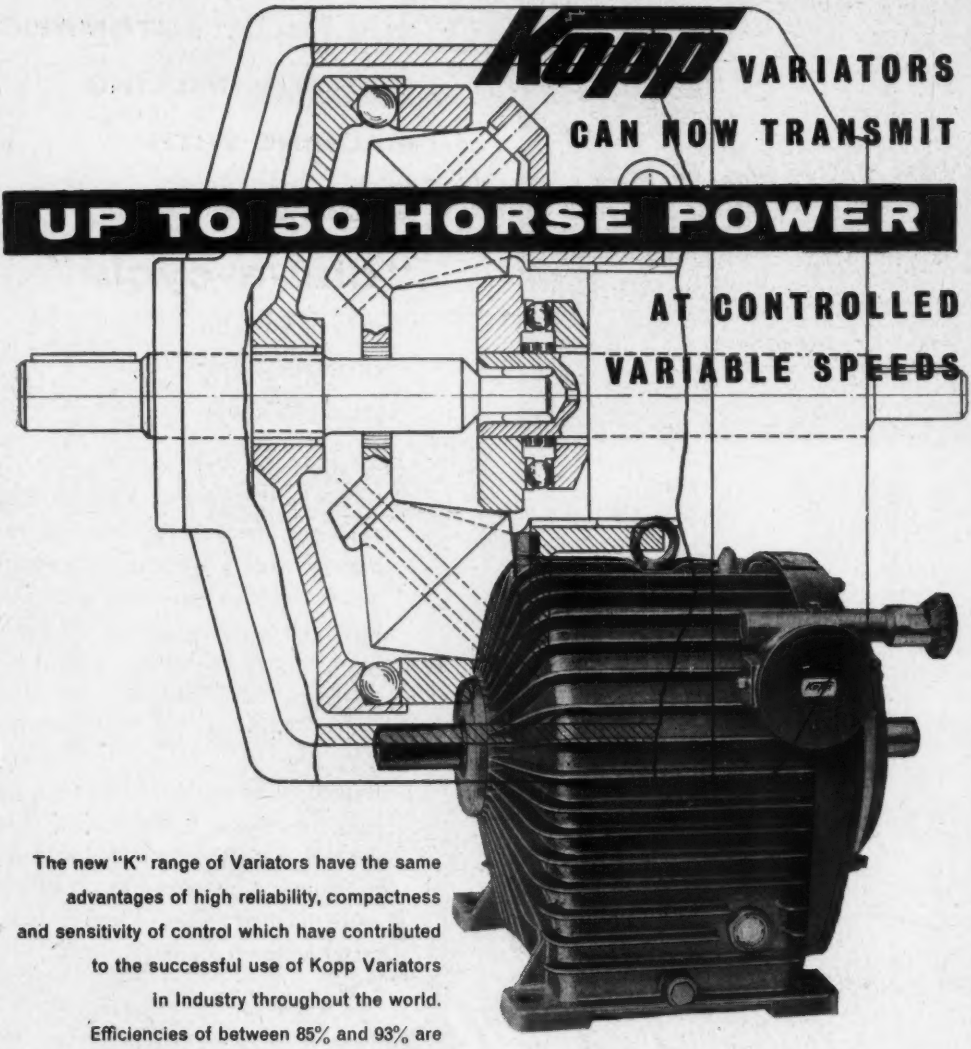

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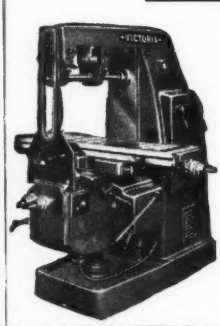

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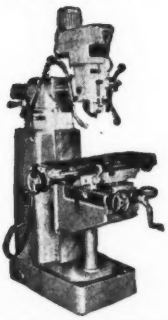

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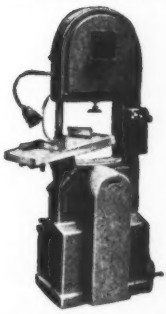

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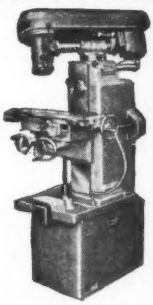

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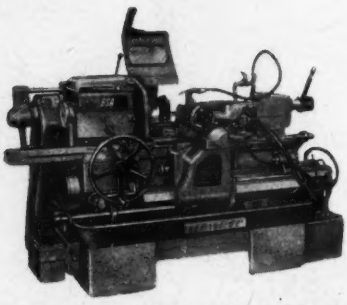
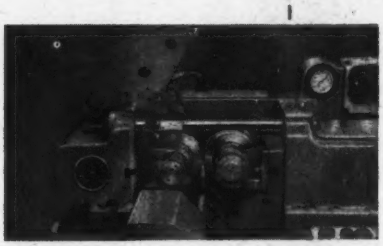
B·S·A production machines

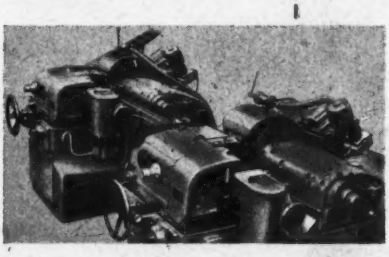


B.S.A. C.L.1 copy turning lathe. For small batch or quantity repetition copy turning multi-diameter shafts, spindles and similar forms. The tracer arm is linked through the hydraulic system to a slide carrying a single-point turning tool. An attachment for copying from a flat template can be supplied as can a rear slide for facing and grooving. Swing over tool slide 8". Distance between spindle flange and tailstock centre 28". Longitudinal travel of tool 26". Transverse stroke of hydraulic slide 2½". Diameter of Master 5½" max. Spindle speeds 217 to 1,810 r.p.m. Feed range 0.003" to 0.030".

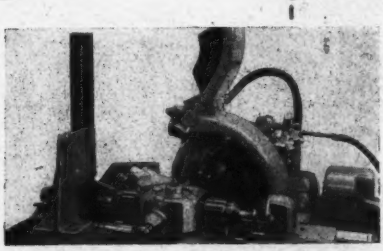
B.S.A. single-spindle automatic screw machines are made in several types including ½", ¾", 1", 1¼", 1⅝" and 2" diameter capacity. Turrets have six stations, but eight station turrets can be fitted to the larger machines. All sizes are arranged for double indexing of turret. A wide range of attachments includes screw-slotting, nut tapping, rear end drilling, cross drilling, spindle brakes and devices for automatic loading for second operation work.



B.S.A. form generator equipped for rolling threads ⅜" dia. on both ends of rod-type component. Two pieces rolled per revolution of the dies, output 90 components per minute. Components are fed from a hopper with an internal adjustable locating plate which permits feeding of parts varying from 4⅜" to 6" long and holds 1,000 workpieces.



Two B.S.A. No. 8 centreless grinding machines linked for transfer of component for two operations. A chute type magazine gravity-loads workpieces to an endless chain conveyor. On completion of grinding on the first machine the components are passed by intermediate conveyor to the workplate between the wheels of the second machine for another grinding operation.



Cup type components delivered from a magazine are received by revolving collets on the turret faces and presented to the chuck for machining from the cross slides on this **B.S.A. 5M fully automatic chucking machine.** Turret index brings a finished component to the station where it is stripped from the collet pneumatically while the succeeding component is being machined. Cycle times: 9 to 15 seconds (depending on the size of the component for which the set-up is adjustable).

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in.	in.	in.	lbs/ft	abt. ft	in.	in.	in.	lbs/ft	abt. ft	in.	in.	in.	lbs/ft	abt. ft
1.26	.79	.22	2.59	10—15						1.26	.63	.30	3.19	11—15
1.42	.98	.20	2.78	9—13	1.42	.79	.30	3.71	12—17	1.42	.63	.37	4.31	11—15
1.57	1.10	.22	3.38	9—13	1.57	.98	.28	4.04	11—16	1.57	.79	.37	4.97	9—13
1.77	1.26	.24	4.15	10—14	1.77	1.10	.32	5.14	7—11	1.77	.79	.46	6.72	10—14
1.97	1.42	.26	4.99	10—14	1.97	1.26	.33	6.11	9—13	1.97	.98	.46	7.79	8—13
2.20	1.57	.30	6.36	9—13	2.20	1.42	.37	7.59	7—11	2.20	1.10	.51	9.74	10—14
2.48	1.97	.22	6.09	9—13	2.48	1.57	.42	9.81	12—17	2.48	1.26	.57	12.2	7—11
2.80	2.20	.26	7.86	12—17	2.80	1.77	.45	12.5	9—13	2.80	1.42	.64	15.5	12—17
3.15	2.48	.30	10.1	11—16	3.15	1.97	.52	16.1	8—13	3.15	1.57	.69	19.9	10—14
3.54	2.80	.33	12.7	11—16	3.54	2.48	.47	17.1	8—12	3.54	1.97	.69	23.2	8—12
3.94	3.15	.35	14.9	13—18	3.94	2.80	.50	20.6	8—13	3.94	2.20	.76	28.4	7—10
4.17	3.15	.45	20.0	10—14	4.17	2.80	.61	25.5	7—11	4.17	2.20	.87	33.5	8—13
4.41	3.54	.38	18.4	10—15	4.41	3.15	.54	25.5	8—13	4.41	2.48	.85	35.5	8—12
4.65	3.54	.48	24.1	8—11	4.65	3.15	.66	31.2	6—9	4.65	2.48	.95	41.3	7—10
4.92	3.94	.43	23.3	8—12	4.92	3.54	.69	31.2	6—9	4.92	2.80	.94	43.9	6—10
5.20	4.17	.45	25.7	7—11	5.20	3.54	.76	38.6	7—11	5.20	2.80	1.06	51.3	5—8
5.51	4.41	.48	29.2	6—9	5.51	3.94	.69	39.8	7—11	5.51	3.15	1.04	54.7	5—8
5.91	4.92	.43	28.5	10—14	5.91	4.17	.76	46.6	6—9	5.91	3.15	1.21	66.7	4—6
6.30	5.20	.48	33.9	8—12	6.30	4.41	.83	54.1	5—8	6.30	3.54	1.21	72.6	3.5—5.5
6.69	5.51	.52	38.5	7—10	6.69	4.65	.90	62.0	4—7					
7.09	5.91	.52	41.0	6—10	7.09	4.92	.95	69.2	3.5—6					
7.48	6.30	.52	43.5	2.5—4	7.48	5.20	1.00	77.3	2—3.5					
7.87	6.30	.69	59.7	2.5—4	7.87	5.51	1.04	84.7	1.5—3					
8.35	6.69	.73	66.5	2.3—4	8.35	5.91	1.07	92.7	1.5—3					
8.82	7.09	.76	73.9	2—3.3	8.82	6.30	1.11	102.1	1.5—2.5					
9.29	7.48	.80	81.3	1.5—2.5	9.29	6.69	1.14	110.9	1.3—2					
9.84	7.87	.87	93.4	1.5—2.5	9.84	7.09	1.21	125.0	1.3—2					

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	6—15 %	15—24 %
Series 1	O.D. max. 2.2"	O.D. 2.5" and over
Series 2	O.D. max. 2.5"	O.D. 2.8" and over
Series 3	O.D. max. 2.8"	O.D. 3.15" and over

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Normal delivered properties:
Yield point: abt. 50 000 psi
Tensile strength: abt. 78 000 psi
Elongation: abt. 20 % on $11.3\sqrt{A}$
abt. 27 % on $5.65\sqrt{A}$
Brinell hardness: abt. 165

After tough hardening*
(wall thickness max. abt. 1.2")
Yield point: abt. 71 000 psi
Tensile strength: abt. 92 000 psi
Elongation: abt. 15 % on $11.3\sqrt{A}$
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*Water quenching from abt. 860°C, tempering at abt. 600°C.

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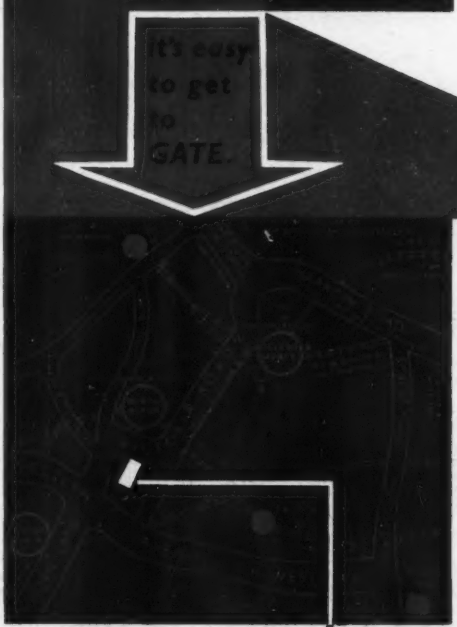

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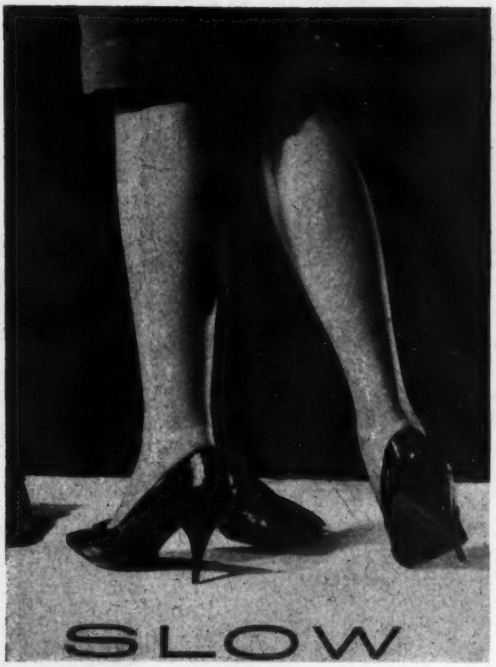

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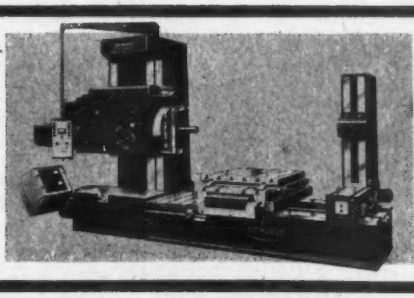
Photo by courtesy of the George Richards & Co. Ltd., Broadheath, Altrincham



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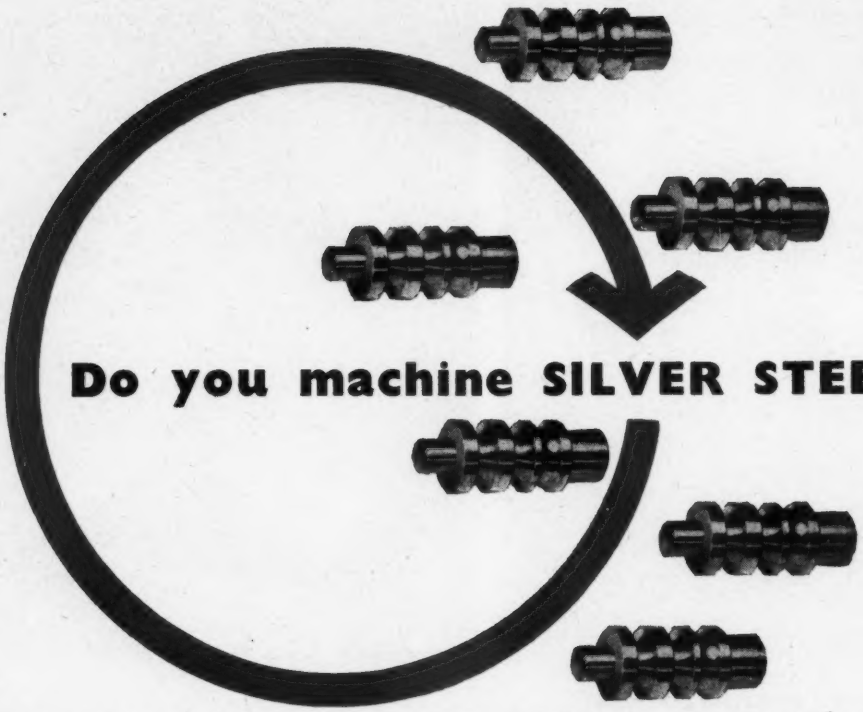

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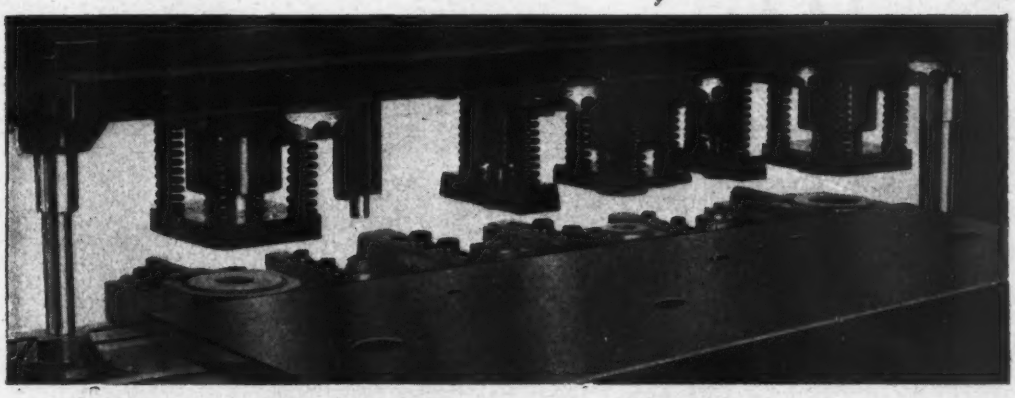

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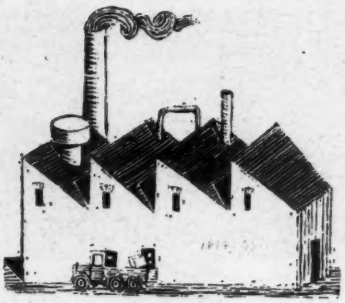

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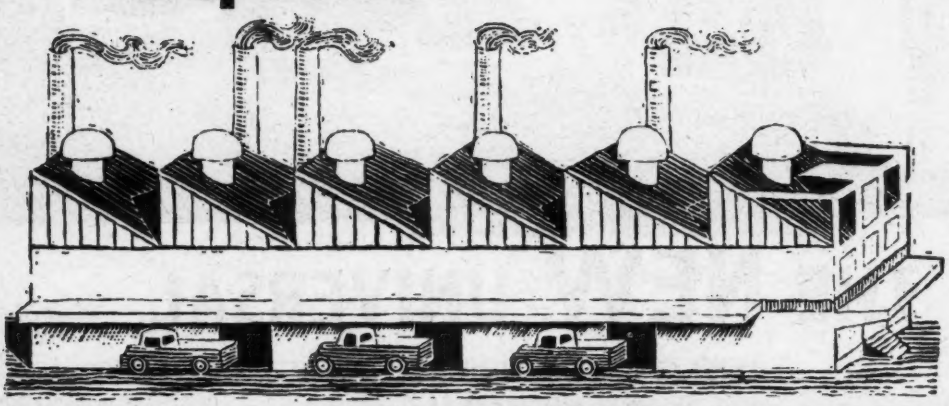

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Saw blades from 11in. to 72in. dia. for sawing work 1in. to 26in. dia. Machines can be supplied as standard or with automatic bar feed.

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New vice which can grip on both sides of the saw blade, giving burr free cuts. Patent applied for.

Chip conveyor for removing the swarf from the machine into a container.

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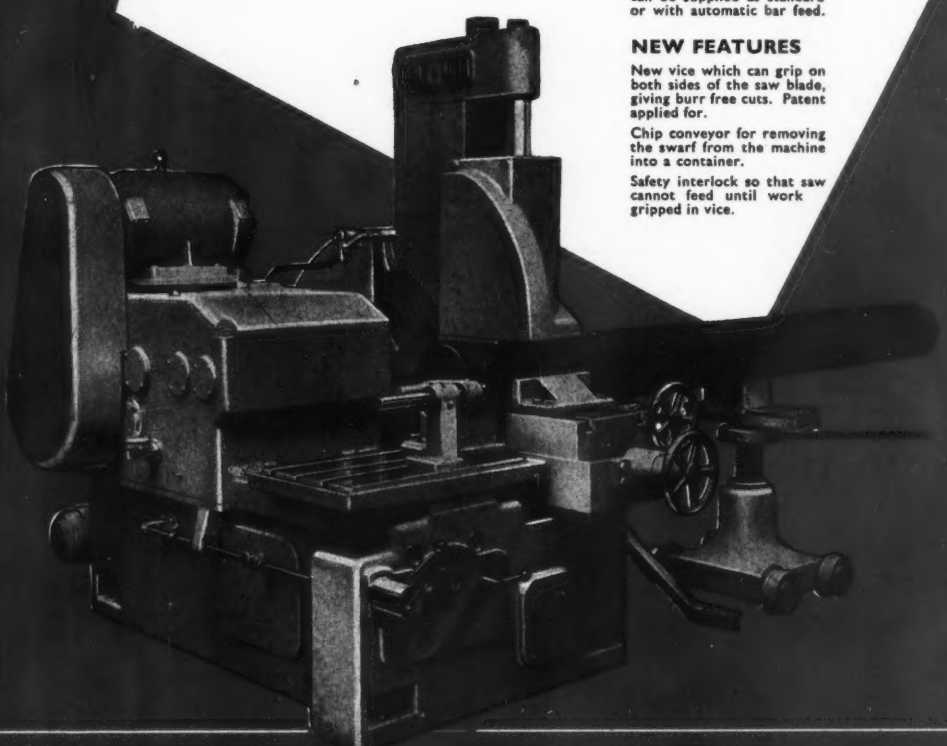

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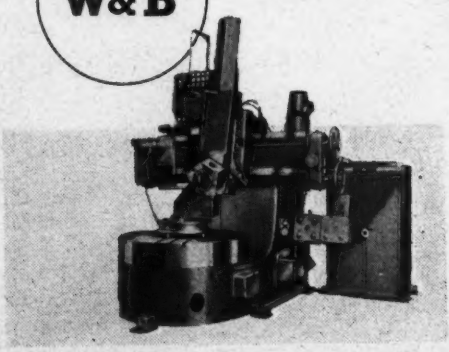

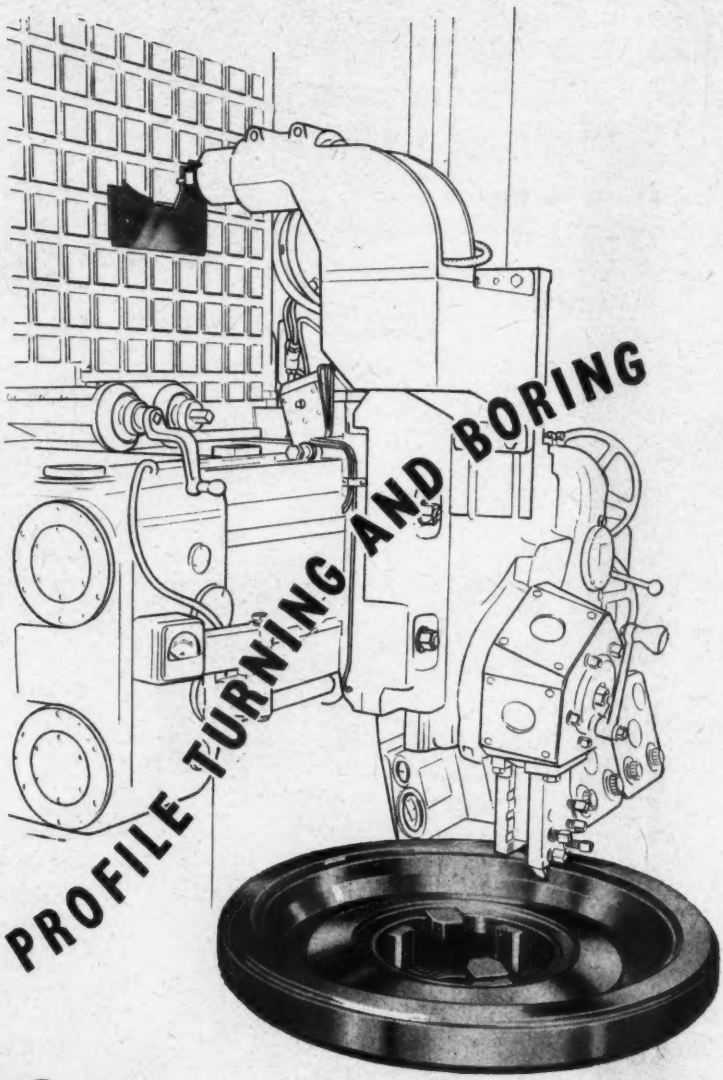

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HEENAN *Multiform*

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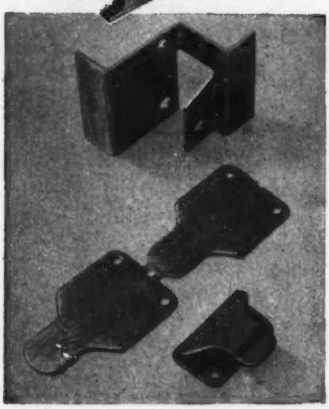
For forming heavy gauge parts from strip up to 3 inches wide and 12 inches developed length.



Designed with the die space 31 inches long and accommodating three individually operated diesets, if required, each 10 inches long, the Heenan S.3 Multiform is particularly suitable for the automatic forming of parts requiring substantial presswork, such as piercing, stamping, coining, blanking, embossing and trimming, using progression tooling. Press rams can be operated from front or rear, with 30 tons loading to each ram.

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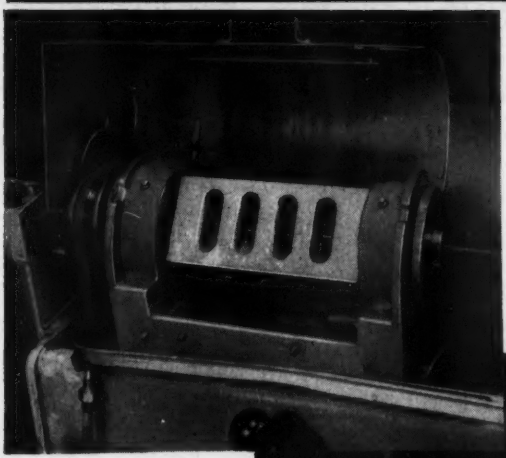
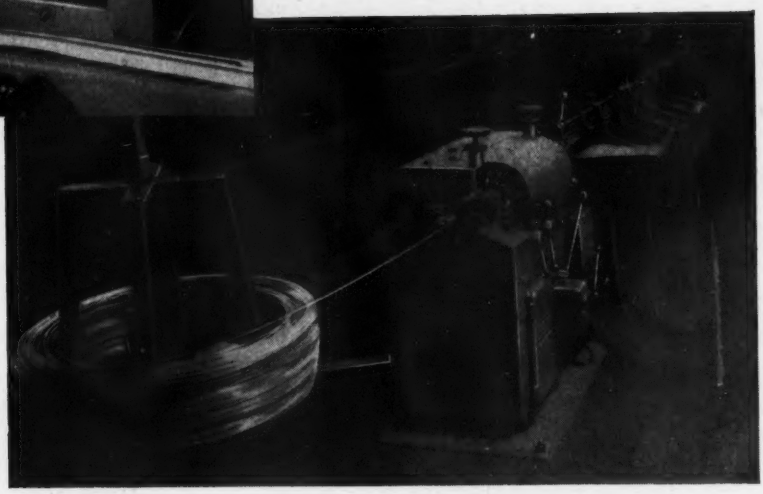


Accurate, High Speed Straightening and cutting off with the M.R & P Type RA machine



Photograph by courtesy of Rylands Bros. Ltd. Warrington

at Rylands Bros., Ltd

This M.R & P Wire Straightening and Cutting-off Machine Type RA4 is in continuous use on wire ranging from 8-21 S.W.G. Rylands Bros. have a number of RA machines of various sizes installed in their Works and particularly appreciate their reliability on high speed work to close tolerances.

The RA4 machine is one of seven sizes to handle wire from 0.020in. to 11/16in. dia. in a wide range of materials. Setting up is simple and quickly accomplished, therefore change-over times are short.

To ensure maximum efficiency on every type of wire, six feed rates and two spinner speeds are provided.

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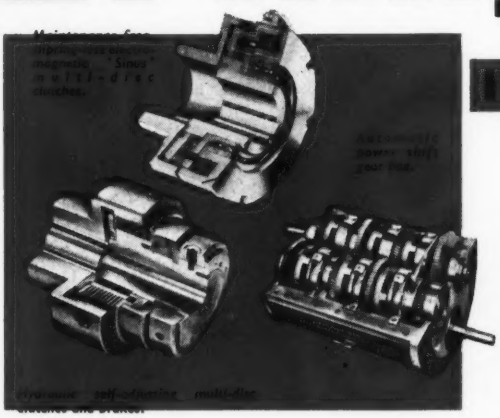

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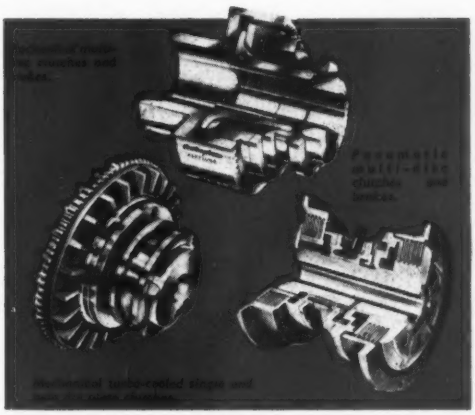

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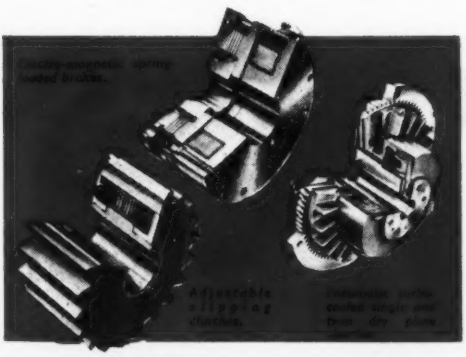

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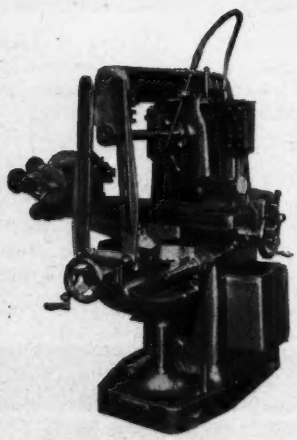
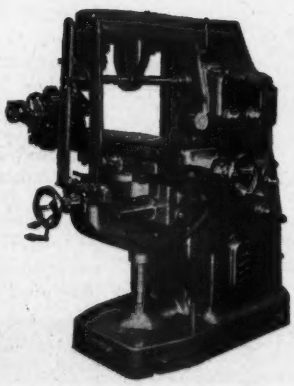


Model 1



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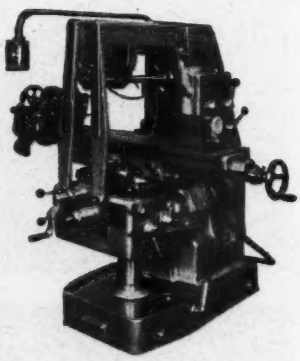

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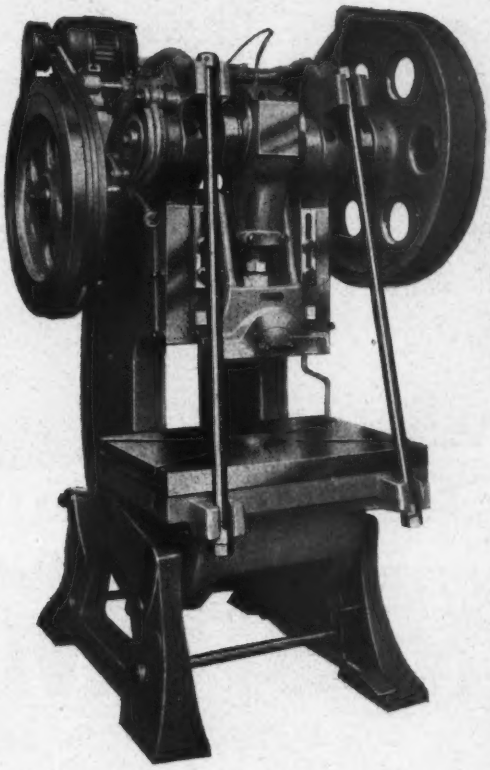

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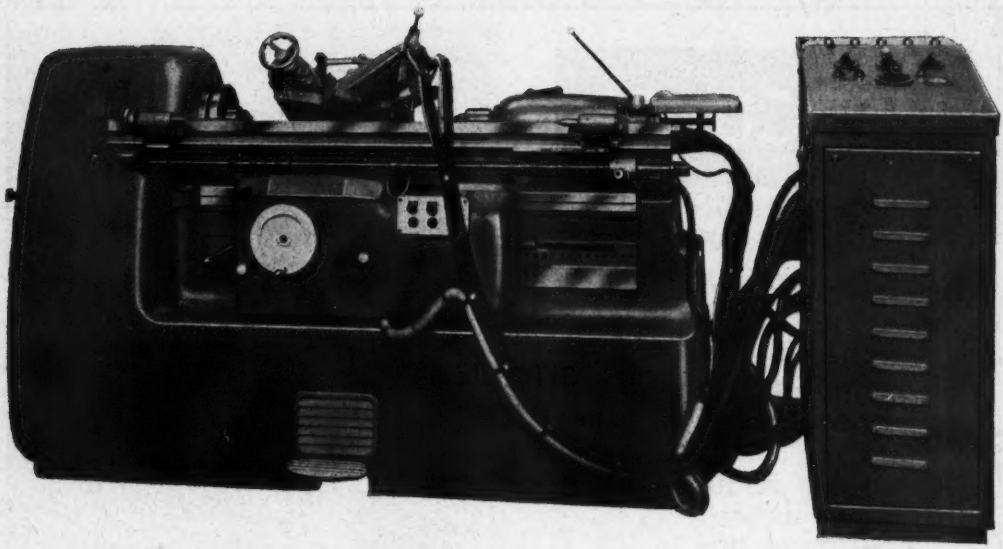

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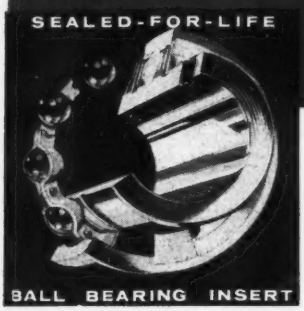

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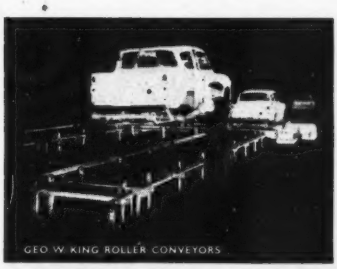
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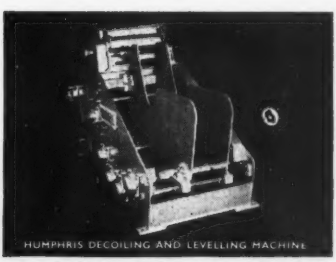
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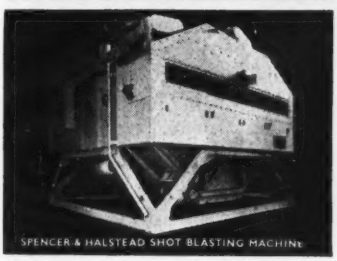
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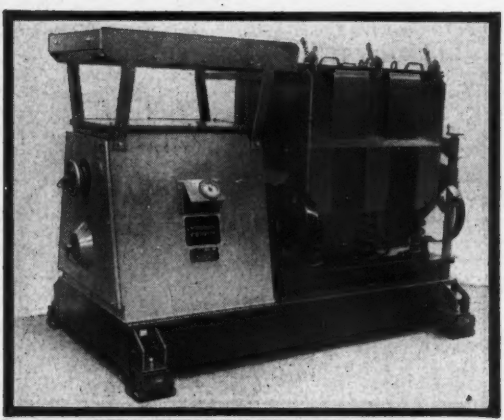

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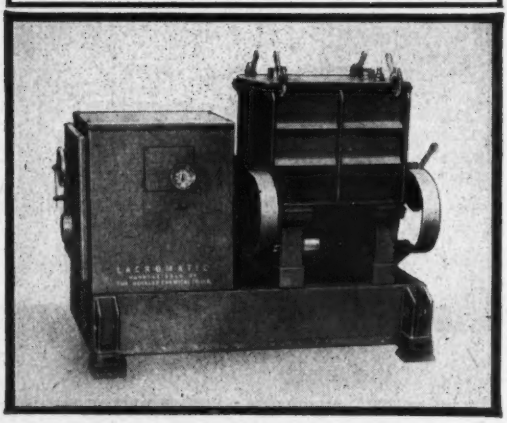

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Managing Director: LESLIE R. MASON
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PRICE PER COPY:—One shilling and threepence.

SUBSCRIPTIONS:—Inland and overseas, 52 shillings per annum (and pro rata), post free. Cheques and Money Orders should be made payable to the Machinery Publishing Co., Ltd.

ADVERTISEMENTS:—Copy for displayed advertisements, if proofs are required, should reach the Brighton office 21 days in advance of publication. Rates on request.
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MACHINERY

A JOURNAL OF METAL-WORKING PRACTICE & MACHINE TOOLS

Vol. 99, No. 2559 November 29, 1961

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COPIES PRINTED	11,500 per week
CERTIFIED DISTRIBUTION	11,293 per week
CERTIFIED PAID DISTRIBUTION	9,827 per week
Copies sold at full price	9,594 per week
Copies sold at reduced prices	233 per week

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Abstracts of Principal Articles

Making the New Borg-Warner Automatic Transmission .. .. .. P. 1236

In this third article of a series, operations on aluminium alloy pressure die castings, which are assembled to produce the hydraulic valve block for the new Borg-Warner automatic transmission, are described. At the first operation on the larger casting, the joint surface is fine-faced on a machine fitted with a double-sided fixture, at each side of which there are two positions. Two holes to be used for dowel location at subsequent operations are then drill-reamed, and a side surface is fine-faced on another machine. Various drilling, chamfering, reaming, and tapping operations follow, and the castings are then passed to two similar machines on which six valve bores are core-drilled and semi-finish reamed at successive operations. Finish reaming is then carried out on two fine-boring machines, with stepped reamers which are held in special chucks designed to ensure that run-out is held to very close limits. Details are given of the design of the reamers and of the methods employed for sharpening them in a soundproof room in which the operator can detect contact between the diamond wheel and the tool by ear. (MACHINERY, 99—29/11/61.)

Special Machine for Sorting Screws P. 1245

A special machine has been designed and built by the Factories Department of the G.P.O. for sorting salvaged instrument screws after barrel plating. This machine handles screws at a maximum rate of 30 lb. per hour, and efficiency of sorting is within 2 per cent. There are two main units, a vibratory linear feeder and a vibratory bowl feeder. Foreign matter, such as washers and short ends of wire, are removed by sieving in the linear unit, after which the screws are visually inspected, and those outside the range of sizes required are removed manually. The screws pass to the bowl feeder and travel through a series of stages for sorting by length, next by head size, then by thread diameter. (MACHINERY, 99—29/11/61.)

Richards Type SB 35 Horizontal Boring Machine with Tape Control .. P. 1265

George Richards & Co., Ltd., have recently built a type SB 35 horizontal boring, drilling and milling machine equipped with punched tape control for positioning the spindle head and the table. The machine is generally similar to the company's table type, but has outboard supports for the saddle to prevent deflection at the extremes of the table cross-traverse. Automatic hydraulic clamping is provided for the table on the saddle ways and for the spindle head on the column. The control equipment is housed in a separate console, and the positioning system is of the type developed by the Staveley Research Department. For each motion, there is a stainless steel reflection grating which is scanned by a 4-phase cursor, incorporating four transmission gratings and associated photo-cells. Absolute accuracy from a given datum ranges from ±0·0005 to 0·0011 in. depending on the length of traverse, and accuracy of repetition is ±0·0002 in. (MACHINERY, 99—29/11/61.)

Some Aspects of Die Design for Gravity Casting .. .. P. 1271

This article includes abstracts of two papers presented at a symposium on die design held recently by the Light Metal Founders' Association in Birmingham. In the first paper, on basic principles of die design, the advantages and disadvantages of various runner layouts and venting arrangements were discussed, also core and die coating. Methods for removing runners and risers, and location of die members were also considered. In the second paper, on cost control in the gravity casting process, attention was first drawn to the factors affecting die design, and mention was made of the highly mechanized dies employed in the production of pistons in large numbers. Similar arrangements for mechanical operation of dies for other types of casting, it was pointed out, can be employed economically, and an air-operated die for an impeller casting was described. Power operation of other dies is obtained by means of hydraulic cylinders, supplied from self-contained units installed alongside the individual dies. After discussing runner and riser systems, the author described a method of runnerless pouring developed in the foundry with which he is associated. With this method, power-operated tilting equipment is employed, which enables the die to be filled through the riser without undue turbulence in the cavity. (MACHINERY, 99—29/11/61.)

Index to Exhibits at the 7th European Machine Tool Exhibition Described on pages 1253—1260 of this Issue

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If you know of a more efficient way of designing a tool, gauge, fixture, or mechanism, machining or forming a metal component, heat treating, plating or enamelling, handling parts or material, building up an assembly, utilizing supplies, or laying out or organizing a department or a factory, send it to the Editor. Short comments upon published articles and letters on subjects concerning the metal-working industries are particularly welcome. Payment will be made for exclusive contributions.

EDITORIAL

The Importance of Human Sciences

In the introduction to the latest booklet* which has been added to the "Problems of Progress in Industry" series issued by the Department of Scientific and Industrial Research, it is pointed out that whereas research "into materials and products, processes and operations, is commonly accepted by forward looking firms in industry as essential to technical progress," there is no such unanimity as regards research into the human factor in production. "Many firms call in technical experts to advise them on some new equipment they are planning to install or on problems that arise in the operation of existing plant," but comparatively few "even consider the possibility of seeking expert advice on problems concerned with the men and women who operate the machines or run the plant." At the same time it is evident that although the nature of the human contribution may have changed as a result of more intensive mechanization its importance has not been lessened. "Indeed, when machines become more complex to operate and maintain, it is often the capacity of the human operator rather than of the equipment that places the limit on the productivity of the man/machine team."

The first section of the booklet is concerned with studies of human efficiency and attention is drawn to the value of the work that has been carried out in laboratories in connection with physical and mental capacities, and the ways in which they are affected by various factors. Studies have indicated, for instance, that the human brain deals with incoming information either as a single item or as groups of items received one at a time. Only a certain amount of decision-making about action can be done within a given time, and if insufficient time is spent, errors are made. The success of selection and training methods depends on careful analysis of particular tasks, and on matching the demands of those tasks and the abilities of individuals. Results of a considerable amount of research into the nature and organization of industrial skills have already been applied in industry. It is suggested, indeed, that the effectiveness of selection techniques, and "the ability of most people to adapt themselves to most situations, however difficult, have led industry in the past to neglect the improvement of efficiency by fitting the job to the man." In this field of ergonomics, however, there has also been considerable progress in the direction of developing "principles of human behaviour which, when applied to the design of equipment and the working environment, will reduce the amount of mental and physical strain, while maintaining and even improving the standard of performance."

Particular attention is drawn to the question of inspection, since decisions as regards acceptance and rejection are still frequently in the hands of men and women. Investigations have shown that there may be wide differences between the numbers of items rejected out of the same test batch of products, not only by different inspectors, but also by the same inspector on different occasions, "even when gauges and meters are used to measure the products." For the purpose of reducing such inconsistencies, "better selection, adequate training, careful definition of faulty products, provision of samples of good and bad products as reference standards, objective tests to check individual accuracy, and spells of refresher training," are recommended.

Researches of the type so far considered can show what a man is capable of doing, but "this does not mean that he will always do it." Further work has therefore been carried out to determine what it is that motivates people in industry, and how various kinds of incentives can affect them. "Research is gradually revealing patterns in human relations that themselves make for harmony or discord. It is also beginning to show how the organization of a factory can affect both the pattern of human relations and the efficiency of its operatives." Obviously the success or comparative failure of incentive payment systems as a means of increasing production may be of vital importance. In this connection it may be noted that one research team has found that the following factors, among others, may influence the results obtained: variations in flow of materials and in products, problems of setting comparable rates for different jobs, the social characteristics of the employees, trade union organizations, the history and prospects of the industry, and the state of the market for its products.

There are no known laboratory techniques which will enable research workers to determine, for instance, the impact that technical change may make on the organization and structure of a firm and on human relations within it. Consequently it

(*Continued on page* 1288)

* Human Sciences Aid to Industry, Problems of Progress in Industry, No. 12. H.M. Stationery Office. Price 2s.

Making the New Borg-Warner Automatic Transmission

Operations on Pressure Die Cast Aluminium Valve Block Components

By R. E. GREEN, Associate Editor

REFERENCE TO THE DESIGN of the new—type 35—automatic transmission now being produced at the Letchworth, Herts., factory of Borg-Warner, Ltd., was made in MACHINERY, 99/764—4/10/61. In that article attention was drawn to the enlargement of the factory to provide the necessary extra capacity for the production of 400 of the new transmissions per 8-hour shift, and some of the operations on the pinion carrier, which forms part of the epicyclic reduction gear incorporated in the transmission, were described. A subsequent article, published in MACHINERY, 99/888—18/10/61, was concerned with the production of ring gears and pinions for the epicyclic gear, and their heat treatment.

Some of the operations on aluminium pressure die castings, from which the valve block controlling the hydraulic operation of the transmission is assembled, will now be described. The valve block assembly includes two large castings, with cored oil-transfer channels, to one of which several smaller castings are attached by screws, after the machining operations have been completed. The intricacy of the channels cored in the castings will be apparent from a study of the examples of the two large castings, as shown in Fig. 1. These two castings are secured to opposite sides of a thin steel aperture plate in the finished assembly, and no seals are employed at the joint faces, which must be flat within 0·0003 in. and with a surface finish of 32 micro-in. r.m.s., to ensure leak-free assemblies under pressures up to 100 lb. per sq. in.

The larger casting has six, and the smaller casting two bores—all except two being of stepped form—in which are housed the valve spools for controlling the flow of hydraulic fluid from the gear-type pumps to the various cylinders and other hydraulically-operated members. The surfaces

within these bores are required to have a mirror finish, and strict limits are imposed for diameter and concentricity, as will be explained.

MACHINING LINES

Machining of the two castings shown, and of other aluminium die castings produced by the pressure and gravity processes, is performed on a portion of the factory floor devoted entirely to aluminium components. In this area will be installed the large Burr [Geo. Kingsbury & Co. (Machine Tools), Ltd.] automatic transfer machine for the complete series of operations on the pressure die cast aluminium main transmission case, which will form the subject of a further article in this series. Extending parallel with the space reserved for this machine are several lines devoted to operations on various aluminium parts, and two of these lines provide for machining the upper and lower valve bodies shown in Fig. 1.

The sequence of operations, and the methods employed, are somewhat similar for the two castings, and the feeds and speeds are also generally of the same order. Facing operations, for instance, are carried out at a surface speed of about 2,000 ft. per min., with a feed rate of some 10 in. per min., and for reaming the valve bores the surface speed is 550 ft. per min., and the feed, 0·0015 in. per rev. At present, all the pressure die castings employed in the new transmissions are being supplied from the U.S.A., by the Doehler-Jarvis company.

Arrangements are now being made for the production of these castings by the newly-formed company, Metal Castings Doehler, Ltd., of Worcester. Batches of castings are inspected on arrival at the factory for correct size and position of cored holes, absence of surface defects, and the presence of a minimum stock for machining. The castings are then passed from the stores to the starting ends of the two parallel lines on which the machining operations are performed. Plan and sectional views of the larger of the two cast-

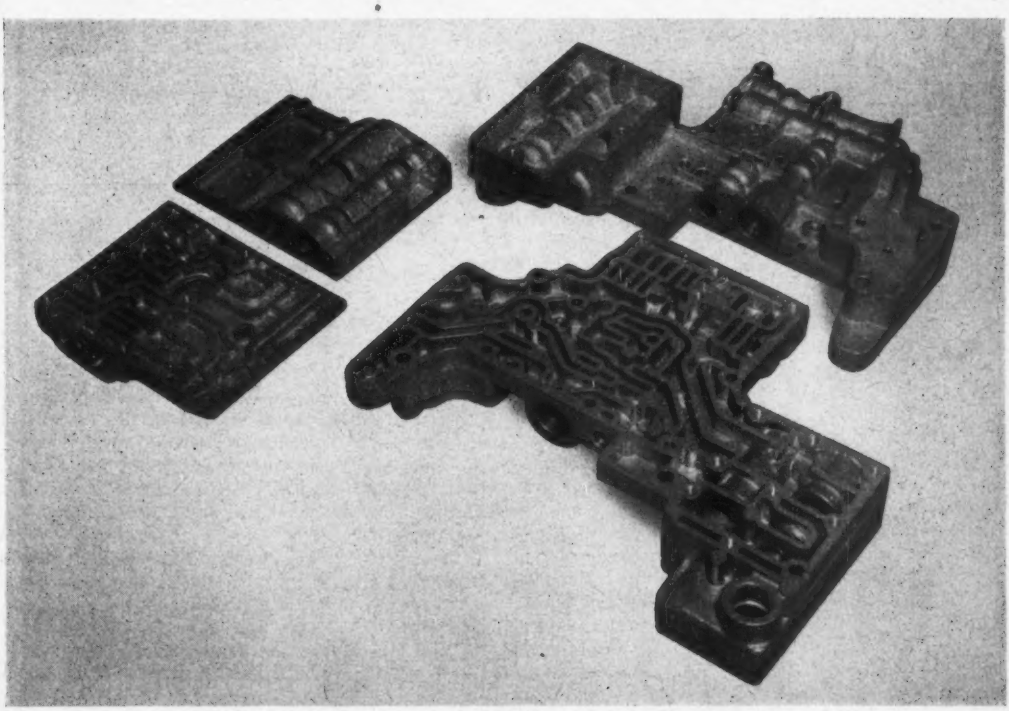


Fig. 1. The two largest castings from which the valve block for the new Borg-Warner automatic transmission is assembled are here shown fully-machined. Cored channels in the opposing faces are separated by a steel aperture plate in the assembly

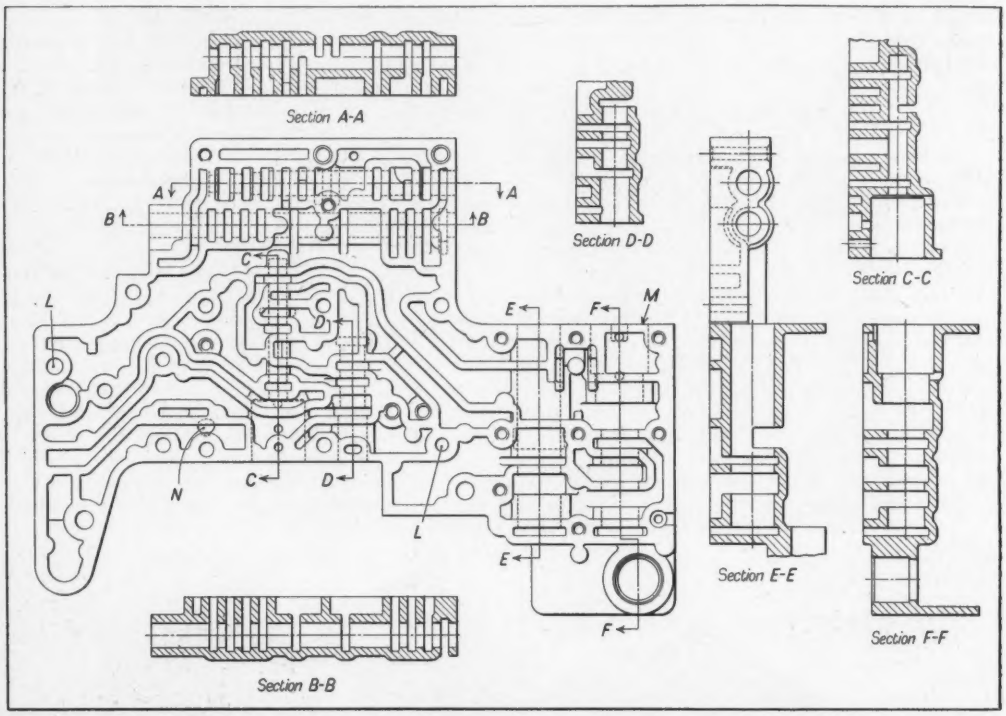


Fig. 2. Plan and sectional views of the larger of the two castings in Fig. 1, which incorporates six valve bores, four stepped and two plain, with limits of 0·001 in. on diameter and 0·0005 in. on concentricity

ings are given in Fig. 2, and it is made from LM 24 M aluminium alloy containing 3 to 4 per cent copper and 7·5 to 9·5 per cent silicon, the tensile strength being 11·5 tons per sq. in.

FACING OPERATIONS

The first operation on the larger casting is performed on a Heald (Alfred Herbert, Ltd.) type 322 Borematic, double-ended, fine-facing machine, as shown in Fig. 3. This machine is of conventional fine-borer construction, with spindle heads carried on bridge members at each side of a central hydraulically-operated table, which has compound motion to provide for approach and lateral traverse movements. The fixture on this table is of double-sided construction, and the two sides are similar, unloading and loading of one side being carried out while the workpieces on the other side are being machined.

At each side of the fixture there are two similar clamping positions, of which the nearer is seen empty, and the further loaded, in Fig. 3. Location of the casting in each fixture is taken from the opposite ends of two of the cored valve bores indicated at *B-B* and *D-D* in Fig. 2, the casting being loaded with the rectangular housing at one end downwards. In this position, the lower end of the bore *B-B* is engaged with a spring-loaded, taper-ended dowel projecting from the top face of the housing *G*, Fig. 3. Directly above this housing there is a vertical slide, operated by the hydraulic cylinder *H*.

This slide carries a second taper-ended dowel, which engages the upper end of the valve bore when the cylinder is actuated to move the slide downwards. Similar arrangements are provided for the location of the casting from one end of the bore *C-C*, Fig. 2, which is horizontal when the work is in the fixture, the small cylinder *J*, Fig. 3, being employed to advance a horizontal slide carrying a dowel for each of the two fixture positions. These cylinders, from the range made by Pratt Precision Hydraulics, Ltd., are fed pre-

ferentially with oil during the locating and clamping sequence, through a solenoid valve controlled by a switch at the front of the fixture. When the locating dowels have been advanced, pressure oil is admitted to the larger Maxam clamp-operating cylinders at the top of the fixture.

The rams of these cylinders are connected to centre-pivoted levers, as at *K*, each of which has an enlarged, forked end, projecting through a slot in the fixture wall above the upper edge of the casting. When the projecting end of this lever is moved down, force is applied to the casting to thrust the lower edge into contact with a serrated face near the bottom of the fixture. Support against the thrust exerted by the facing cutters is provided for the portion of the casting containing the bores *A-A* and *B-B*, Fig. 2, by means of a horizontal, spring-loaded plunger, in the lower part of the fixture.

This plunger can be locked, in any axial position to which it is brought during the loading and clamping of the casting, by means of a star wheel. Only one adjustment of the plunger position is usually made for each batch of castings. After the two positions at one side of the fixture have been loaded, a button is pressed to set the machine so that facing operations on the newly-loaded parts start immediately after the table has returned to the central position.

Each of the spindle heads is equipped with a facing cutter in the form of a disc, thickened at the edge to accommodate three equally-spaced single-point cutting tools. These tools are of solid Carboloy, and they are held in the disc on a pitch circle of about 11 in. diameter, each tool projecting by the same amount on a particular disc. The two disc cutters at each side of the machine are employed to take successive roughing and finishing cuts across the casting surfaces, the depth of the roughing cut being about 0·03 to 0·04 in., and of the finishing cut, 0·005 to 0·010 in. For finishing, the tools are set out by the appropriate extra amount from the face of the disc, in relation to the roughing tools.

Each spindle is driven at a speed of 350 r.p.m., and the machining cycle starts with the upper slide of the table in the rearmost position. The table is fed towards the cutters, up to a stop, and the cross-slide is next traversed to carry the castings past the tools, the table then being returned to the starting position. Approach and withdrawal of the work to and from the cutters takes place under rapid-traverse. The datum face established at this stage is employed for location of the casting in the required plane for subsequent machining.

DRILL-REAMING LOCATION HOLES

Drill-reaming of a cored hole at each end of the casting to diameters of 0·194/0·195 and 0·254/0·255 in., is next carried out on a Pollard type 15 AY pillar machine. Indicated at *L* in Fig. 2, these holes are employed for location of the casting during later machining operations, and they are finished with the aid of the simple jig seen in Fig. 4. This jig has a bush plate, supported at the corners on pillars which extend upwards from a cast base. Brackets on the base support two parallel, horizontal, cylindrical guide-bars for a travelling carriage, and a plate on this

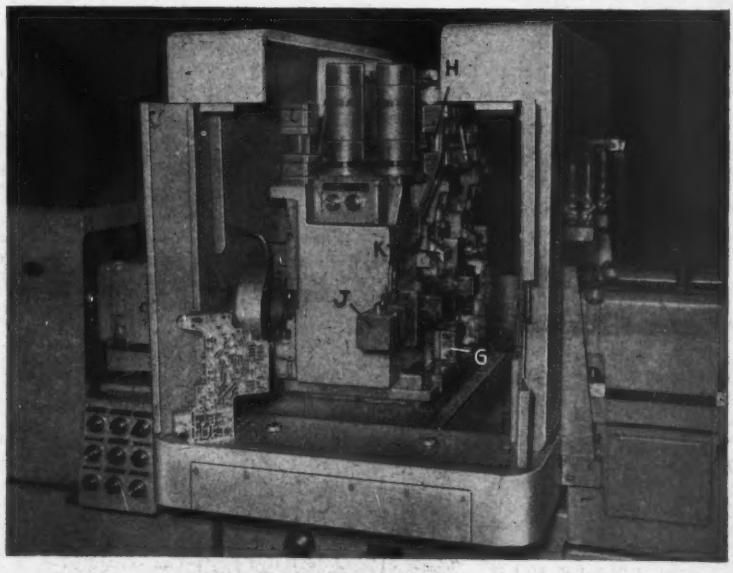


Fig. 3. The joint faces on two of the larger valve body castings are machined at one setting on this Heald type 322 Borematic machine, while the opposite side of the fixture is being unloaded and re-loaded

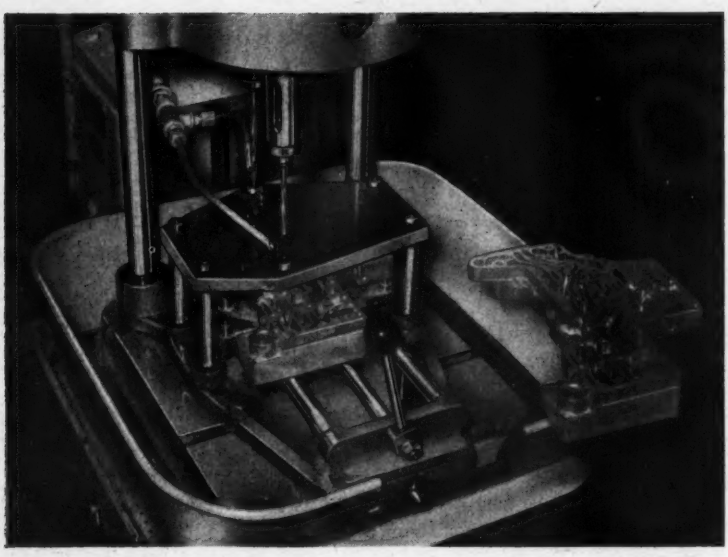


Fig. 4. For drill-reaming two holes employed for dowel-location of the casting at later stages, this jig is employed on a Pollard 15 AY machine. The casting is clamped to the under-side of the bush-plate

carriage has dowel pins to engage two holes cored in the lower surface of the casting, towards the rear.

Between the guide bars there is a shaft with a ball-handled lever at the outer end, the inner end being housed in brackets on the carriage. At this end there is a cam which raises the work-plate when the shaft is turned by means of the ball handle. When loading, the casting is placed on the work-plate with the joint face upwards, the cored holes being engaged with the dowels. The carriage is next moved forward to the position shown by means of the ball-handled lever, which is then turned to raise the work-plate on its guide pins, against the pressure exerted by coil springs. With the casting thus clamped to the under-side of the bush-plate, the drill-reamers in the 2-spindle head are fed down manually. A spindle speed of 364 r.p.m. is employed, and after the holes have been finished the casting is released from the bush-plate by turning the cam-shaft, and the carriage is withdrawn for unloading.

Next, the casting is passed to a type 222 Heald single-spindle fine-facing machine for a second face-milling operation. The set-up on the Heald machine is shown in Fig. 5, and it will be seen that the part is held with the previously-machined

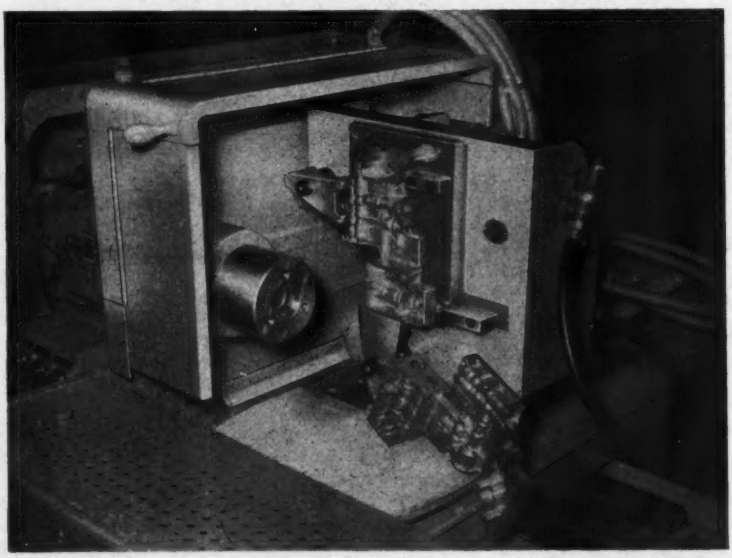


Fig. 5. A side surface on the valve body casting is faced with a single-point Ardoloy tool on this Heald type 222 machine. The triangular clamps are arranged to swivel through 90 deg. during retraction

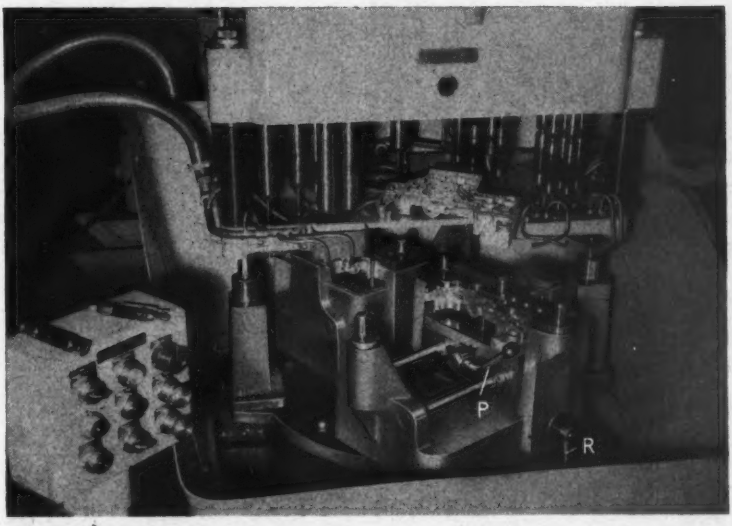


Fig. 6. Fitted with a multi-spindle head and 2-position indexing fixture, this Mulhead machine provides for drilling certain bolt and oil-transfer holes which could not be conveniently cored, and for tapping operations

joint surface in contact with a vertical face on the fixture. Location is taken from dowels which enter the two holes reamed at the previous operation, and the casting is held in position by two clamps of triangular shape, fitted with nylon pads which prevent damage to the surfaces.

These clamps are attached, near their centres, to the rams of two hydraulic cylinders, mounted on the far side of the vertical portion of the fixture, and the arrangement is such that they are swivelled through 90 deg. when the cylinder rams are energized, so that they clear the casting edges in the retracted position. Facing of the surface *M*, Fig. 2, is performed on this machine by means of a single-point Ardoloy tool, which is adjusted to leave some 0·007/0·008 in. of material for removal at a later grinding operation.

A spindle speed of 1,500 r.p.m. and a feed of 10 in. per min. are employed, and a mixture of soluble oil and water is applied.

DRILLING AND TAPPING OPERATIONS

Drilling, chamfering, and reaming operations are next performed at a single stage, on a Pollard machine, to complete the machining of the hole *N*, Fig. 2, the axis of which is at an angle of 18 deg. to the rear face of the casting. In the simple fixture employed, the casting is located by dowels on a face inclined at the required angle, and held in place by a toggle clamp, while the combination tool in the spindle is fed by hand.

Certain holes, for bolts and oil transfer passages, which could not be conveniently cored in the casting, are next drilled, and other holes are tapped, on the Mulhead Mark 5, 6-station rotary machine, shown in Fig. 6, the table of which is fitted with a two-position indexing fixture. Arrangements somewhat similar to those on the machine in Fig. 4 are employed to locate and clamp the casting at each fixture position, a finished casting being unloaded and a fresh one loaded at every third movement of the indexing table. When loading, the casting is first placed, joint-face upwards, on a work-plate on the sliding carriage, on which it is located by fool-proofing pegs and dowel pins which enter two cored holes in the under-side.

When the carriage has subsequently been moved into the clamping position, where it is held in place by a spring-loaded latch *P*, the work-plate is raised vertically by a cam, on a shaft which is turned by means of the lever *R*. In this position, the reamed holes *L*, Fig. 2, are engaged by locating dowels projecting from the under-side of the bush-plate. The machine cycle is then started by pressing a button on the control panel and the casting is indexed to the left, to positions at which seven holes of 0·118 to 0·656 in. diameter are drilled, two holes of 0·265/0·267 and 0·687/0·688 in. diameter are reamed, and ten holes are tapped No. 10 by 24 t.p.i. N.C. 2B.

Another Pollard pillar type machine, fitted with a multi-spindle head and 5-position indexing fixture supplied by the Ratcliffe Tool Co., Ltd., is next employed for drilling, countersinking and reaming operations on certain holes. Holes are then tapped both in the unmachined side and in the side face *M*, Fig. 2, on a Pollard machine fitted with a Mulhead 7-spindle head, the casting being held in two different positions, in succession, with the large and small joint faces in the horizontal plane.

Fig. 7. After the four parallel bores have been rough-drilled and semi-finish reamed, this machine performs operations on the remaining two parallel bores at *A-A* and *B-B*, Fig. 2

Core-drilling and semi-finish reaming of the four parallel valve bores at *C-C*, *D-D*, *E-E* and *F-F*, Fig. 2, two in the main part of the casting and two in the rectangular housing at one end, is next carried out on a Pollard type 28A pillar drill equipped with a multi-spindle head and 5-position indexing fixture. The castings make two complete circuits of the machine, being loaded first with the side face *M*, Fig. 2, upwards, and subsequently with this face downwards, on opposite sides of a vertical buttress which forms part of each of the five fixtures. Location of the castings is provided by dowels, and they are clamped by cam-actuated bell-crank levers.

Stepped drills are employed for core-drilling all four holes at the first two machining positions, after which the castings are unloaded. One casting is then transferred to the second-circuit side of the fixture and loaded in an inverted position, and a completed casting is transferred to the next machine. The diameters of the core drills, and of the stepped reamers, some of which are carbide-tipped, are such that some 0·020 to 0·030 in. is left on each bore diameter for removal at the finishing stage.

A similar series of operations is carried out on the remaining two bores *A-A* and *B-B*, Fig. 2, on the type 21A Pollard drilling machine shown in Fig. 7, which is equipped with a multi-spindle head and 5-position indexing fixture made by the Ever Ready Tool & Engineering Co., Ltd. In the fixture, which is of somewhat similar design to that provided for the previous operation, the casting is held in a vertical position, and located by dowels on a flat surface to which it is clamped by a cam-actuated lever. The bore *B-B*, Fig. 2, is plain, but the bore *A-A* is stepped, and correspondingly-stepped tools are provided. Vaughan's Cut-max 31 cutting oil is employed for these drilling and reaming operations.

FINISH-REAMING THE VALVE BORES

Finish-reaming of the six valve bores is carried out on two more Heald machines, one of which operates on four and the other on two of the bores. A close-up view of the first of these machines is given in Fig. 8, and the castings are washed in a water-soluble compound to remove swarf before they are loaded into the 2-position fixture. Operations are performed on two of the four parallel bores at each of the two fixture positions, a casting being thus completed at each machine cycle. The parts are located by dowels on flat-surfaced projections on the top of the fixture, the small faces of these projections being more easily kept clear of swarf.

Clamping is effected by swivelling, hydraulically-operated pads, which bear on the castings directly above the support surfaces mentioned, and carry fibre pads to prevent damage. During the automatic work cycle, the table moves first to the right and then to the left, in a straight line, to present the various bores to the tools. Special 4-bladed, carbide-tipped, stepped reamers are employed for this work, and each is held in a Hydra-lock chuck designed to ensure true running within very close limits.

Each tool has a cylindrical shank which is held in a close-fitting, thin-walled sleeve in the chuck, only a small clearance being provided to permit insertion. Surrounding the sleeve there is a second, split,

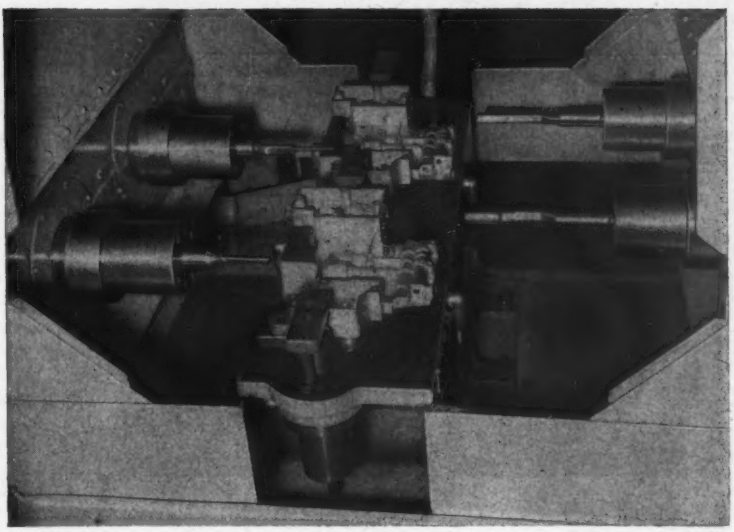


Fig. 8. Close-up view of the tooling area on the Heald type 222 machine employed for finish-reaming the four parallel valve bores to limits of 0·001 in. on diameter and 0·0005 in. for concentricity. The reamers are held in Hydra-lock chucks

sleeve, and a small space around the latter is filled with grease, to which pressure can be applied by turning a screw in the front face of the chuck. Seals at each end of the inner sleeve prevent the grease from escaping, and the hydraulic pressure is thus applied to this sleeve which is compressed to grip the tool shank. Variations in tool shank diameters up to 0·0005 in. can be accommodated, but for different shank diameters different sleeves must be employed.

The tipped reamers are driven at speeds of 2,500 to 3,500 r.p.m., according to diameter, and the table is fed at 3·75 in. per min. for these operations. Similar methods are employed for finishing the two bores *A-A* and *B-B*, Fig. 1, on the second Heald machine, which has twin-spindles and is of single-ended design.

REAMER GRINDING OPERATIONS

The bores are required to be held to a tolerance on diameter of 0·001 in., and in the four stepped bores the diameters must be concentric within 0·0005 in. total indicator reading. In addition, the internal surfaces of the bores are required to have a 50-micro-inch, r.m.s., surface finish, and to present a highly-reflective appearance. The reamers employed, a typical example of which is shown in Fig. 9, are therefore required to be finished to very close limits, the shank diameters being ground and

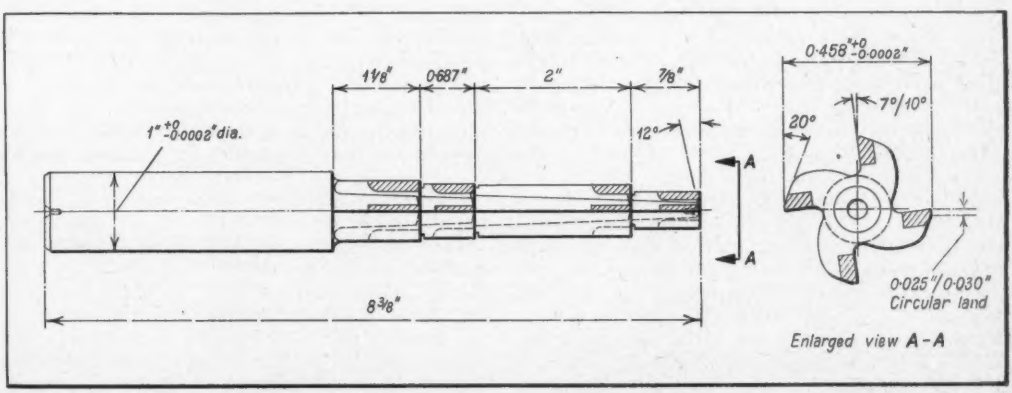


Fig. 9. Side and end elevations of a typical reamer employed for finishing operations on the four stepped and two plain bores in the valve body casting. Each diameter in the bores is machined by four end-cutting carbide-tipped teeth, as here shown

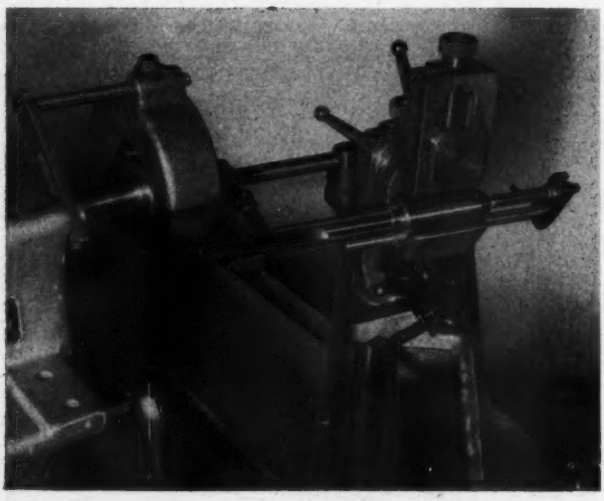


Fig. 10. The teeth of the finishing reamers used on the machine in Fig. 8 are reground on this Jones & Shipman type 310 cutter grinder, which is installed in a sound-proof room

lapped to within +0 −0·0002 in. of nominal size.

Each reamer is tipped with grade AF Ardoloy (Alfred Herbert, Ltd.) tungsten carbide, at the positions corresponding to the steps in the bore to be machined, and the four flutes are machined with a front rake angle of 7 to 10 deg. which is also applied to the carbide tips. A circular land 0·025 to 0·030 in. wide, on the outside of each flute is ground and lapped to the nominal diameter of the portion of the bore to be machined within the same limits as are maintained on the shank size, and concentricity of all the diameters is held within 0·0002 in. total indicator reading. The surface finish of these lands must be between 5 and 8 micro-inches, and the rear edge is backed off at an angle of 20 deg. It may be noted that a maximum taper of 0·001 in. per inch of length is allowed on the various portions of the tool.

With these reamers, cutting takes place only on the corners of each set of four teeth, and smooth surfaces can only be obtained if the amount of material removed is equally shared between them. The teeth are ground with an end-cutting clearance angle of 12 deg., and it is essential that their corners should all be in the same plane, normal to the reamer axis. In resharpening the reamer teeth, it is important that no more material should be removed than is necessary to restore the original condition, and some difficulties were encountered in connection with this operation in the early stages. These troubles were associated with the fact that the light cuts taken on the tooth surfaces produced no sparks and only faint sound, so that it was difficult for the operator to determine when the work was in contact with the wheel. It was decided that the sound of the wheel in contact with the carbide tip was likely to afford the most reliable indication of contact, and a sound-insulated room, part of which is seen in the heading illustration, was therefore provided in one corner of the tool and cutter grinding department. In this room are installed a Christen [G. Zwicky (London) Ltd.] and a Jones & Shipman type 310 cutter grinding machine, the latter being seen in the close-up view, Fig. 10, which also shows some details of the reamer design.

Grinding of the end-cutting faces of the reamer teeth is performed on the Jones & Shipman machine with the modified tool holder shown, which is fitted with a steel bush. The bore of this bush is ground and lapped to a very close fit on the shank of the tool, which is positioned axially by a ground centre carried on an outrigger. For angular location of the cutter, a substantial spring steel blade is arranged to bear against the flute face in the normal manner. Sharpening is carried out in two stages, for the first of which the machine spindle is fitted with a cup-shaped diamond-impregnated wheel of 150 grit size (Wellson Abrasive Products, Ltd.).

For finishing, a 400-grit diamond wheel of the same make is employed, which removes any burrs and ensures smooth cutting edges. Grinding is performed with the face of the wheel, the work axis being set at the required angle by adjustment of the swivelling table and the tool-holder unit.

Further operations on valve body castings will be described in another article, to be published shortly.

FIRE EXTINGUISHERS IN THE NEW PLUS RANGE introduced by Nu-Swift, Ltd., Elland, Yorks., are pressure-charge-operated and contain chlorobromomethane or carbon tetrachloride, with carbon dioxide added, and are stated to be of improved efficiency. The new extinguishers will supersede the present Nu-Swift Auto extinguishers, but pressure charges for the old types of extinguishers will continue to be made for a period of 10 years or longer. PLUS extinguishers have been approved by the Fire Offices' Committee, and bear the B.S.I. Kite Mark, to indicate compliance with B.S. 1721.

Special Machine for Sorting Screws

By G. HALEY, B.Sc. (Eng.), A.M.I.E.E.*, and L. P. WILSON†

ACTIVITIES OF THE FACTORIES DEPARTMENT of the G.P.O. include the repair and renovation of telephone equipment—principally that used at customers' premises—in large quantities. There are several factories within the department, and that at Cwmcarn, Mon., is devoted entirely to the repair of telephone instruments and bells, which can be handled at rates up to 500,000 per year. At this factory, flow-line methods are employed both for dismantling the complete telephone instruments on receipt, and for subsequent re-assembly.

Telephones of a number of different designs may be dealt with simultaneously, and for this reason, among others, it is not possible to maintain segregation of the various sizes of instrument screws removed on the dismantling lines. This circumstance gave rise to the problem of sorting mixed 4 B.A. and 5 B.A. screws of different types, at the rate of approximately 100 lb. per day, with sufficient accuracy to enable them to be used by the operators on the assembly flow-line, and at the minimum cost.

After some study of the problem, a sorting machine was developed which is here described. This machine has now been installed in the Cwmcarn works, and has proved capable of sorting mixed screws into seven required categories, at a maximum rate of 30 lb. per hour.

Examples of the seven types of screws involved are shown in Fig. 1. All are of electro-plated cheese-head type, with heads of various diameters and threads of 4 or 5 B.A. form, in lengths of ¼ or ⅜ in. All the screws recovered from the dismantling lines are re-plated with nickel, by the barrelling method, before they are sorted, and the batches of screws contain a proportion of waste material—comprising unwanted screws, washers, wire, connectors and other parts. Fig. 2 shows a selection of surplus items which are typical of those that are likely to be fed to the sorting machine. Fortunately, the trash is not excessive—amounting to only about 5 per cent of a batch by weight—but it must be eliminated before the main sorting process can take place.

SORTING PROCEDURE

The sorting procedure is shown diagrammatically in Fig. 3, and the first stage provides for the removal of trash by both sieving and visual examination. This stage serves to eliminate many subsequent stoppages, by preventing oddly shaped pieces of trash entering and jamming the gauges of the sorting unit.

All screws have to be sorted for length, and this operation can be performed very rapidly and is not likely to suffer from loss of accuracy due to overloading. Sorting for length was therefore made the next stage in the sequence, followed by sorting for head size. By exploiting an association of head size and length of thread, it has been found possible to limit sorting for thread size (to distinguish between 4 and 5 B.A. screws)

* G.P.O. Research Station (lately of G.P.O. Factories Department).
† G.P.O. Factories Department.

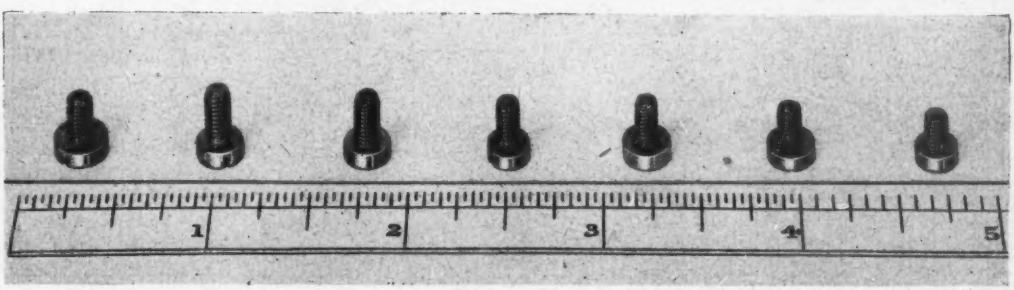


Fig. 1. Range of 4 B.A. and 5 B.A. screws that are required to be segregated by the sorting machine designed and built by the Factories Department of the G.P.O.

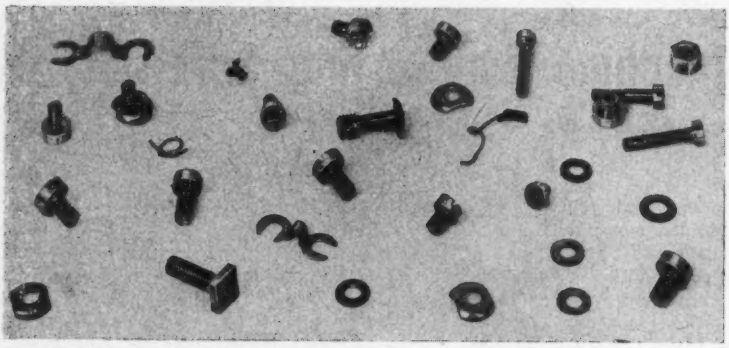


Fig. 2. A typical sample of the mixed components that are likely to be fed to the sorting machine for instrument screws

to only one length and head combination—namely, medium head, ¼ in. long. This particular sorting operation is probably the slowest in the sequence, and it has therefore been arranged that the sorting equipment for this stage is the most lightly loaded.

Fig. 4 is a general view of the screw sorting machine, and it has been found possible to arrange for all the sorting operations to be performed along the spiral tracks of a 24-in. diameter vibratory-bowl feeder *A*, and to employ a simple linear vibratory feeder *B* for in-feeding and trash removal. Segregated screws fall through guide tubes into plastics trays, as at *C*, in the lower part of the supporting framework of the machine. The tubes are mechanically independent of the vibrator. When the trays are full of screws, they are removed and delivered to the telephone assembly flow-lines.

INPUT FEEDER

The arrangement of the input feeder will be clear from Fig. 5. Screws to be sorted are loaded manually into the hopper *D*, which can accommodate a maximum charge of 10 lb. The lower end of the hopper is about ½ in. above one end of the table of the linear vibratory feeder, on to which the screws and other materials are discharged. This table is arranged in three sections, as indicated at *E*, *F* and *G*, which are mounted together, and work is fed from right to left, as viewed in the illustration.

Section *E* is in the form of a plain tray and ensures that there is a reasonably uniform flow of screws from the hopper to the sieving cascade *F*, which provides for the removal of loose washers, wire and other foreign matter. Greater difficulty than was expected was experienced in the design of the cascade. For example, it was found that many of the washers had a tendency to ride over some of the more obvious types of sieving arrangement, and were carried with the screws to the next section of the machine.

The final design, which has proved very satisfactory, comprises four layers of rods, each of

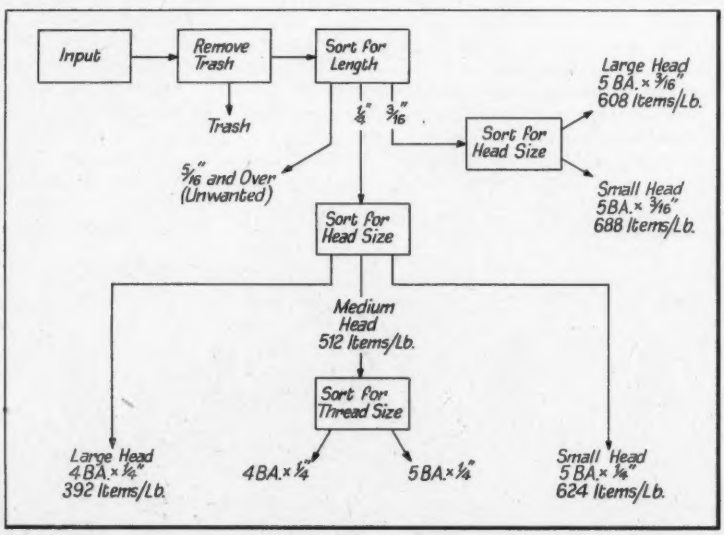

Input
Remove Trash
Sort for Length
Trash
1/8" 3/16"
5/16" and Over (Unwanted)
Sort for Head Size
Large Head 5 BA. × 3/16" 608 Items/Lb.
Small Head 5BA. × 3/16" 688 Items/Lb.
Sort for Head Size
Medium Head 512 Items/Lb.
Sort for Thread Size
Large Head 4 BA. × ¼" 392 Items/Lb.
4BA. × ¼"
5 BA. × ¼"
Small Head 5 BA. × ¼" 624 Items/Lb.

Fig. 3. The sequence of sorting on the machine is here shown diagrammatically. Trash is collected in a container for disposal

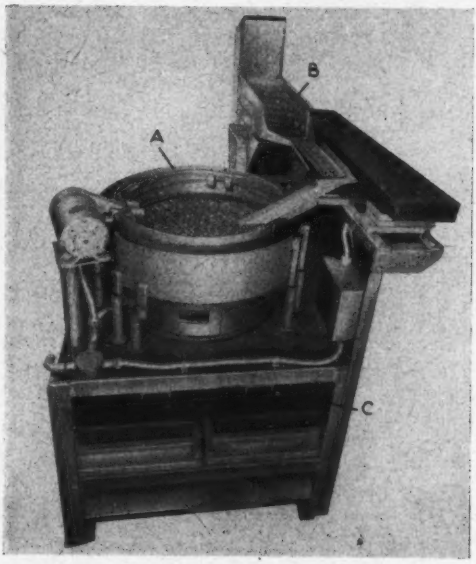


Fig. 4. General view of the screw sorting machine. The principal units comprise vibratory feeders, one of linear type and the other of bowl type

$\frac{3}{16}$ in. diameter. In each layer, the rods are arranged parallel to one another, and are spaced apart so that they are just capable of supporting the heads of the smallest screws to be segregated. The arrangement is clearly shown in the perspective view in Fig. 6, and it will be observed that alternate rods in each layer are of extended length, also that the rods in one layer are staggered relative to those in the layer below. This design gives a very effective sieving action, and ensures that when a washer, for example, lies flat and thus travels along one layer of rods, it tends to be tipped on edge on reaching the end of the layer and thus falls between the rods of the layer immediately below. Connectors, as seen at the upper left in Fig. 2, proved to be the most difficult items of trash to remove, but are effectively sieved by the arrangement shown. All material that falls through the sieving section of the machine is collected in one container for subsequent disposal.

From the end of the sieving section, the screws pass along section *G*, Fig. 5, which has lengthwise corrugations, whereby the screws are caused to travel in four separate streams. The machine is normally tended by an operator, who watches the material passing along section *G*, and removes any foreign matter that is outside the capacity of the sorting section that follows. At the side of the section *G*, there is a padded support for the operator's arms, and this support is carried on rubber mountings to eliminate the transmission of vibration, which would cause discomfort. Examples of the material removed at this stage are exceptionally long screws, screws with washers or wire-ends trapped on them, and nuts. This scrap material is merely dropped into the scrap tray by way of slots that extend along either side of the section. Screws from the end of the section fall into a chute that leads to the bowl of the sorting machine.

It is possible to feed material at a higher rate than can be accepted by the sorting section. The feed rate of the linear feeder is therefore adjustable, and the operator controls the rate to main-

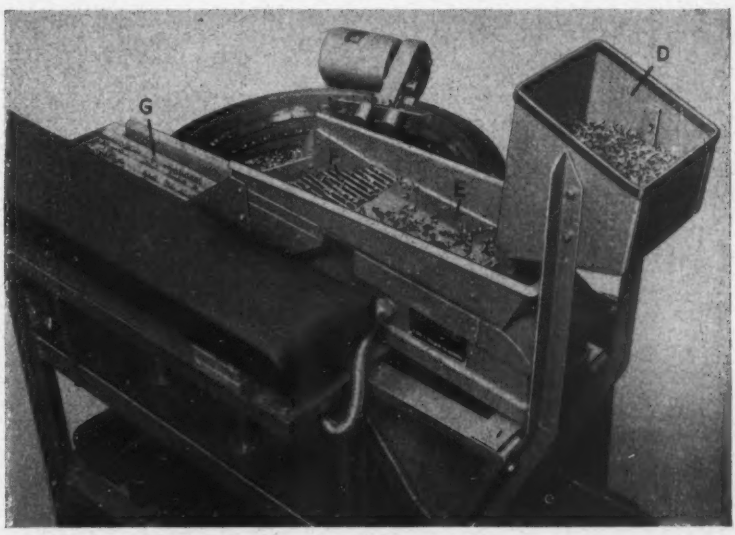


Fig. 5. View of the input end of the linear vibratory feeder, showing the hopper, sieving unit and visual inspection position

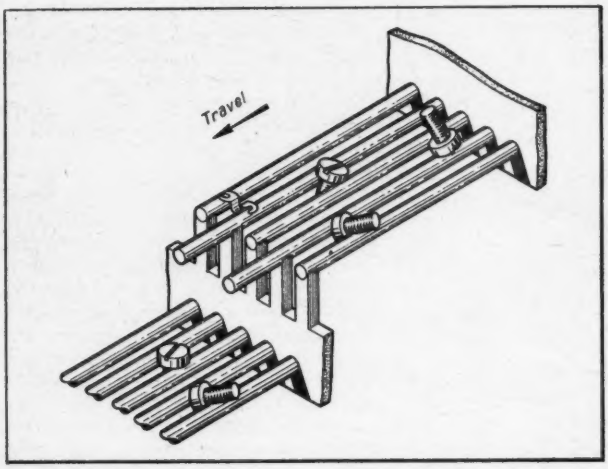


Fig. 6. Perspective view of the sieving section for the removal of trash such as washers, connectors and pieces of wire

tain a constant quantity of screws in the vibratory bowl feeder. The operator is able to stop the linear feeder when auxiliary work—such as emptying a screw tray—has to be performed. In order to avoid dead spots, along which the work would not travel, it was found essential that the vibrating members of the linear feeder should be of light but rigid construction.

SCREW SORTING ARRANGEMENTS

The screw sorting arrangements proper comprise two concentric cylindrical units mounted on a 24-in. vibrating feeder. A circular clockwise motion is imparted to the screws, which enter the centre section of the bowl by way of the chute from the linear feeder. The screws are caused to travel up the first section of a helical track, of arcuate-section sheet steel, on the inside of the inner unit. Most of the screws move with their axes in line with the direction of travel, so that they enter the next section of track correctly orientated.

This next section of track is of a rectangular channel form, and the gap between the webs is of such a width that the shanks of the correctly orientated screws can swing downwards, with the result that the screws travel with the under-sides of their heads resting on the ends of the webs, as seen in Fig. 7. Some screws enter this section with their longitudinal axes at 90 deg. to the direction of travel. Screws of ¼-in. maximum shank length which are misaligned are removed by the arrangement shown in Fig. 7. The channel section is tilted at an angle of 45 deg. to the wall of the unit, and a slot *H* is cut in one side, also in the bottom of the channel. If a screw is correctly orientated, its head bridges the slot and it passes on, up the track. The shanks of incorrectly aligned screws enter the slot, and the screws fall into the bottom of the feeder bowl.

For the removal of misaligned screws of greater shank length, it has been found necessary to provide a double sorting unit of this type with the channel tilted first to the right, then to the left. A sorting section, as described, is provided at each of three positions in advance of other types of sorting units, and forms an essential safeguard against faulty sorting and blockages. About 10 per cent of the screws that travel along the track are incorrectly disposed, and are removed by the above means.

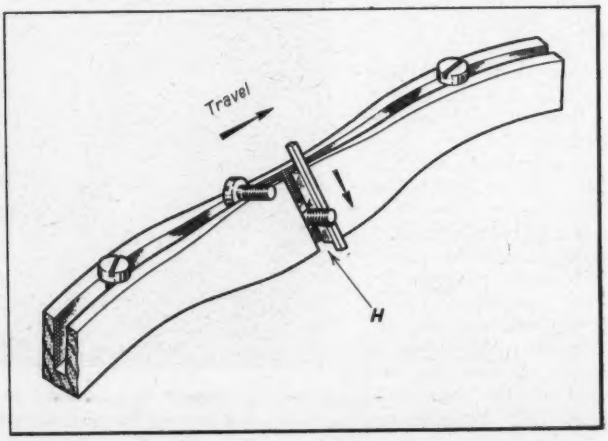


Fig. 7. Perspective view of the unit in the vibratory bowl feeder whereby screws that are not correctly orientated are rejected

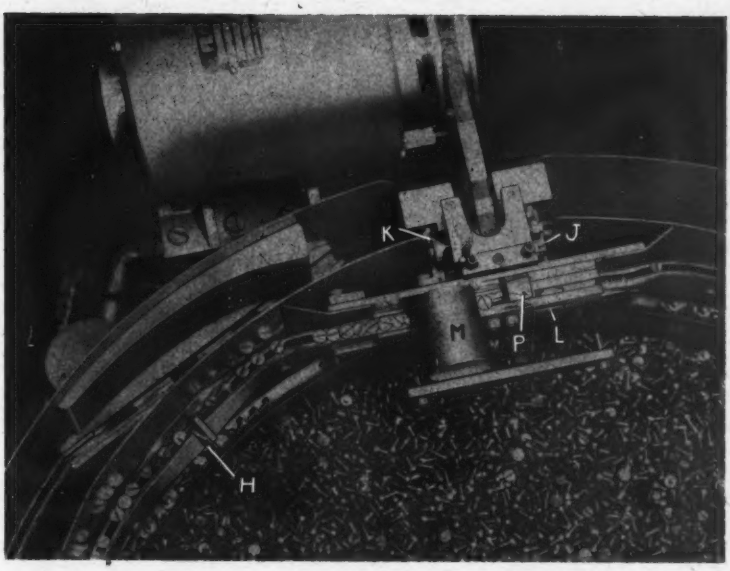


Fig. 8. In this view of the vibratory bowl, from above, may be seen the unit for rejecting misaligned screws and the motor-driven length-sorting arrangements

SORTING FOR LENGTH

In an earlier design of sorting machine, the screws were graded for length by moving them along a track with their heads downwards and their shanks vertical. Diverter arms were located above the track and each arm engaged the ends of the screws of a certain length and tipped them off the track. Although this arrangement was simple, it was inherently inaccurate, since it measured the overall length of the screw and not the threaded portion. Moreover, jamming and over-loading were liable to occur.

The present design was adopted to overcome these weaknesses, and provides for positive sorting of the work. Fig. 8 shows the general arrangement of the section and the preceding sorting unit is seen at the left. The method adopted for segregating the screws is to knock those with shanks that exceed a given length out of the track in which they are travelling, by the action of a rocker arm that contacts the ends of the shanks.

A diagrammatic view of the arrangement is given in Fig. 9, and has been lettered to correspond with Fig. 8, where applicable. There are two similar rocker arms, as at *J*, which are oscillated by ball races that are eccentrically mounted on the ends of the shaft *K*. This shaft is driven at about 7,000 r.p.m. by means of a belt from a small electric motor. The free end of each rocker arm moves in a slot cut in the feed channel *L*, and the tip of the arm, which is about ⅛ in. wide, has a travel of approximately 0·120 in. As the screws pass along the channel, those with shank lengths

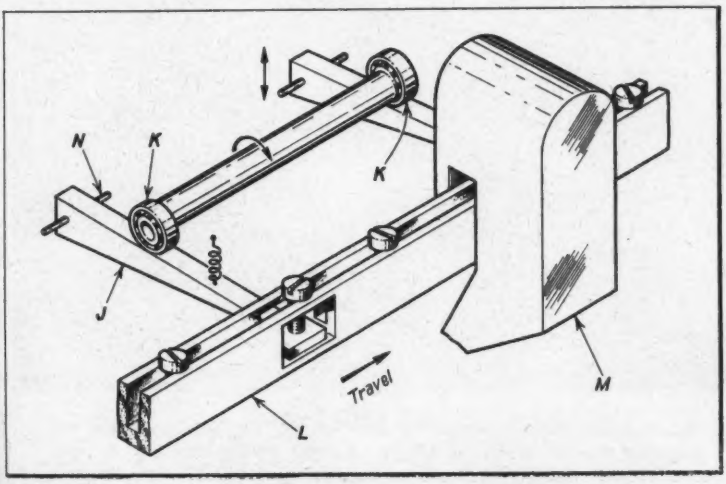


Fig. 9. Details of the arrangements for segregating screws according to their shank lengths may be seen in this diagrammatic view

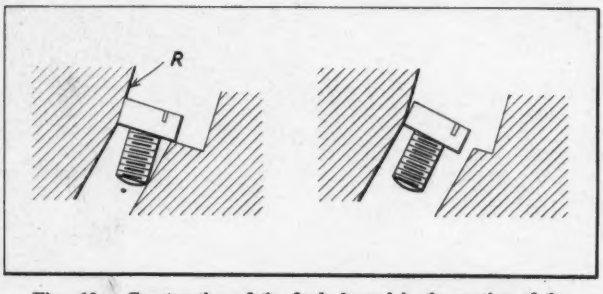


Fig. 10. Construction of the feed channel in the section of the machine for selection by head size. Each screw is supported by only a small area of the under-side of the head, and certain screws fall freely through a gap

exceeding a predetermined value are struck by the end of the rocker arm, and are knocked upwards out of the channel, into a sheet metal cover whereby they are directed into a chute. Shorter screws remain in the channel and travel to further sorting units. In Fig. 8 and 9 the cover over one ejection position has been removed, but the other cover is indicated at *M*.

The upper position of the tip of a rocker arm, and hence the minimum length of screw that is ejected, is determined by the position of the rocker arm pivot *N*, which is provided with screw adjustment. One rocker arm is normally set to eject screws with $\frac{5}{16}$-in., and the other, screws with ¼-in. long shanks. Because of the relatively high speed of the eccentric shaft, the arms have been designed to have low inertia, and attention has been paid to the lubrication arrangements for the bearings.

When the arms are correctly adjusted, it has been found that discrimination of screw length is within 0·005 in., and that flow rates of the order of 250 screws per min. can be handled. Mis-sorting at this stage has been found to average no more than 1 to 2 per cent, and there is no evidence of damage to the threads as a result of impact.

For high rates of through-put, it has been found essential to prevent the screw heads riding up on each other as they enter the section of channel containing the rocker arm. This potential source of error has been eliminated by introducing pivoted flaps, as at *P*, Fig. 8. Each flap presses down on the heads of the screws immediately in front of the rocker arm positions, and ensure that the under-sides of the screw heads are in contact with the track when length sorting takes place.

Screws ejected by the first rocker arm are at least $\frac{5}{16}$ in. long, and are not required. They are therefore fed into a tray, by way of a suitable chute. The second rocker arm ejects screws that are at least ¼ in. long, and these screws are directed into the outer unit for further sorting. The screws remaining in the channel, which are of $\frac{3}{16}$ in. shank length—and in practice form the largest proportion of the input—travel to a position where they are sorted for head size.

SORTING FOR HEAD SIZE

Screws could be sorted for head diameter by

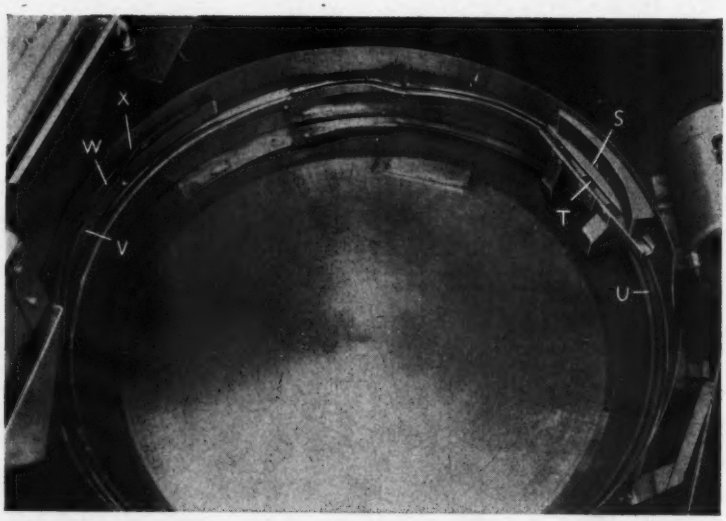


Fig. 11. The vibratory bowl feeder assembly with the inner cylindrical sub-assembly removed so that details of the outer sub-assembly can be seen. This latter assembly provides for sorting only screws with ¼-in. long shanks

the simple procedure of increasing the width of the gap between the webs of the channel. Screws of a head diameter smaller than the gap width would then fall into the bottom of the channel, whence they could be redirected by a suitably-disposed hole and chute. The larger headed screws would then remain suspended from the top of the channel webs, and could be further segregated by successive increases in track width.

Such a simple arrangement is susceptible to jamming, due to the head of a screw becoming wedged diagonally in the gauging slot. An arrangement of this type was adopted, however, and the tendency to jamming was reduced by making the channel of the shape seen in Fig. 10. The gap through which the screw shanks travel is inclined at an angle of 17 deg., with the result that the lower end of the shank bears on the web face at one side of the channel, and the screw head contacts a reference face as at *R* in the left-hand view. With this arrangement, support is given to the under-side of the head on a small area opposite to the reference face *R*, and when this support is removed, at the gauging position, the screw falls freely, as indicated in the right-hand view.

By adopting this technique of gauging against a reference face, the diameter of the screw head is used as a criterion for sorting. Most other arrangements that were investigated provided for measuring the difference in the radii of the head and the shank, and therefore had to be made to much greater accuracy.

The track is extended beyond the gauging position for the largest head, so that any screws with heads exceeding the largest required size fall back into the bowl of the feeder. This procedure was adopted as a further precaution against jamming.

As has already been mentioned, screws with ¼ in. long shanks are directed to the spiral track of the outer unit. Fig. 11 shows the feeder bowl with the inner unit removed, and the screws pass first to a head-gauging section *S*, which segregates the screws into three groups according to head diameter. Screws in the middle size-group may have threads of 4 or 5 B.A., and must next be graded for thread diameter. Screws in this group pass through the middle outlet *T* of the head-gauging section, thence on to a length of spiral track which directs them to the thread-sorting section. This track is seen at *U*, at the right, and access to it can only be gained by way of the outlet *T*. Screws which fall back into the pan immediately prior to thread sorting must therefore pass through the head-sorting section again before being re-delivered to the thread sorting unit.

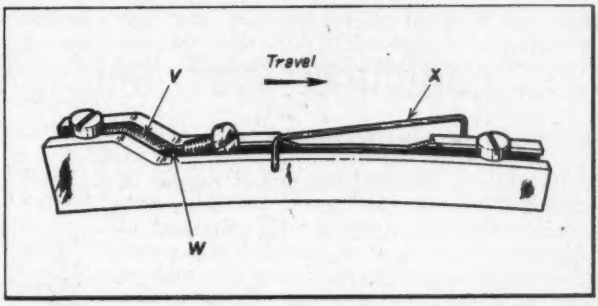


Fig. 12. This perspective view shows the arrangements for segregating 4 B.A. from 5 B.A. screws. The larger screws rest on top of the channel and are deflected by a plough wire

SORTING FOR THREAD SIZE

Before they enter the thread sorting unit, the screws pass through a misplaced screw removal section (as described earlier) to ensure that all screws are travelling with their heads uppermost, and their shanks within the webs of the channel-section track *U*. At the position indicated at *V*, the webs of the channel are machined at an angle of 45 deg. for a length of about ½ in., and this inclined portion leads to a section of track *W*. The arrangement is seen more clearly in the perspective view, Fig. 12, which has been lettered to correspond with Fig. 11.

The gap between the webs of the track in section *W* is 0·128 in. wide, and this gap will accommodate a shank with a 5 B.A. thread, but will not allow a 4 B.A. shank to enter. As the screws descend the inclined portion *V*, they travel with their heads tilted, and when they reach the section *W*, the 4 B.A. screws proceed with their shanks virtually horizontal, on top of the track, whereas the 5 B.A. screws move with their shanks within the track channel.

At the position *X*, the track is cut away at one side, and a plough wire is fitted which spans the track at an angle. There is sufficient clearance between this wire and the top of the track to permit the passage of the heads of the 5 B.A. screws, travelling in the "head up" condition, and these screws pass under the wire to a discharge chute at the end of the track. The 4 B.A. screws, however, which are riding on top of the

track, are ploughed off by the wire, and pass through another opening in line with the cut-away portion, and thence into a discharge chute leading to a container below.

MACHINE PERFORMANCE

The machine described has proved capable of handling 30 lb. of mixed screws per hour, with approximately 500 screws per lb. Removal of trash and the transport of unsorted and sorted screws can be carried out by the operator without stopping the main sorting process. The proportion of mis-sorted screws is less than 2 per cent.

In the design of the machine, attention was directed to minimizing jamming of the tracks and sorting units, and this aim has been achieved. To some extent this result is due to the technique of returning "wrong" screws to the bowl of the machine. Such screws may well include some that were missed at the visual inspection section, and, in theory, there should be a gradual increase in the concentration of such screws in the bowl until a condition is reached such that all screws are fed up the track and rejected into the bowl. Such a condition has not occurred in practice, and the need for completely emptying the machine to allow the bowl to be cleared has not yet arisen. All gauging members were made from mild steel, and were designed so that they could be readily replaced by hardened members, if necessary. Although the machine has been in operation for more than a year (during which it has handled 8 tons of screws) no wear has been apparent, and it would seem that mild steel is adequate for the gauging members.

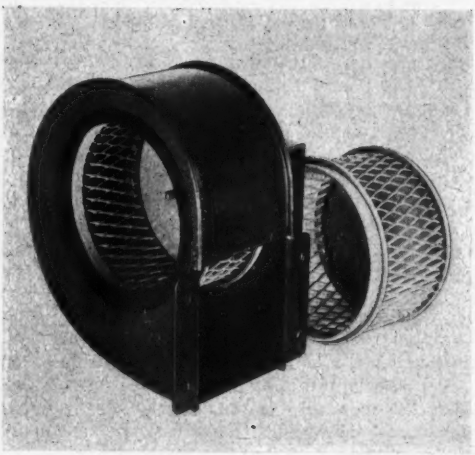
The machine described deals satisfactorily with a limited range of screws and it is interesting to consider how the lessons learnt in its construction could be applied to a machine for sorting a more comprehensive range. It is considered that a good arrangement would be to use a series of linear feeding units, each with a specific sorting function and capable of inter-connection and adjustment to select a limited number of screw sizes from the total input. The first sorting operation for a wide range of screws would undoubtedly be for thread size, and a suitable sorter can be envisaged which would combine the features of the track sieving arrangement and the thread sorting stage of the present machine.

ACKNOWLEDGMENTS

The authors wish to thank the Controller, G.P.O. Factories Department, for permission to publish this article, also the laboratory staff whose patient work made this machine possible. All photographs are reproduced by courtesy of H.M. Postmaster-General.

H.P.R. Mesh Fan

Heat Pump & Refrigeration, Ltd., Landsdowne Lane, Charlton Village, London, S.E.7, have introduced a new type of fan, as shown in the figure, which is the subject of patent applications and is claimed to offer a number of advantages. The impeller, which is of mesh form, is made from expanded metal, plastics, or other material. The mesh has the usual pattern of diamond or similar-shaped openings, and the narrow strands, which become slightly inclined to the plane surface during the stretching operation in manufacture, form, in effect, numerous small scooping blades.



An H.P.R. mesh fan, with a spare impeller

The mesh, when formed into a cylinder and provided with an end plate, serves as a rigid, yet light, centrifugal-type impeller. This impeller is fitted to a motor shaft and enclosed in a scroll-type housing, and when it rotates, the air which is thrown off radially by centrifugal force, is collected and delivered by the action of the small "blades."

Because the mesh fan has a large number of "blades," and low inertia, it can be run at high speed without excessive noise.

Initially, a 4-in. diameter fan with an output of 70 cu. ft. or free air per min. will be available, and fans with outputs ranging from 25 to 200 cu. ft. per min. will be in production early next year.

7th European Machine Tool Exhibition, Brussels

Eighth Article

HURTH LINK-LINE FOR TOOTH-CHAMFERING AND SHAVING GEARS

In Fig. 1 is shown a general view of a link-line for tooth-chamfering and shaving operations on gears, which has been built by Carl Hurth, Munich, Germany, whose agents in this country are Vaughan Associates, Ltd., 4 Queen Street, Curzon Street, London, W.1. The workpiece comprises a gear with 31 single-helical teeth, of stub form, and a smaller-diameter extension on which there are 27 teeth. The latter are of standard involute form, of narrow face width, and serve as a coupling in conjunction with a sliding internal gear.

Components, with both sets of teeth already cut, are loaded on to pegs which project vertically from the conveyor at the extreme right, whereon they are delivered to the chamfering machine, indicated at *A*. The conveyor is a continuous loop, and as a gear reaches the end, it is automatically picked from its supporting peg when the latter is in the horizontal position. It is then transferred to the Hurth type ZK5 chamfering machine, and a special mandrel is advanced to engage with the bore, to support the gear and to index it to bring successive teeth to the cutters. The chamfering machine has twin cutter spindles, arranged one above the other, and they perform milling operations on diametrically-opposed teeth simultaneously.

When all the coupling teeth have been chamfered on both sides (at the outer ends) the gear is gripped by a special transfer arm, which is seen at *B* in the close-up view Fig. 2. This arm is mounted vertically, and at its lower end there is a pair of pincer-type claws. It is lowered, hydraulically, to grip the gear by the boss portion, and is then raised to the position shown in Fig. 2. Next, the complete arm is moved to the left, on slideways provided on the bridge member *C*, by means of a motor-driven endless loop of chain.

Supported by a cylindrical column, bolted to the bed of the chamfering machine, the bridge

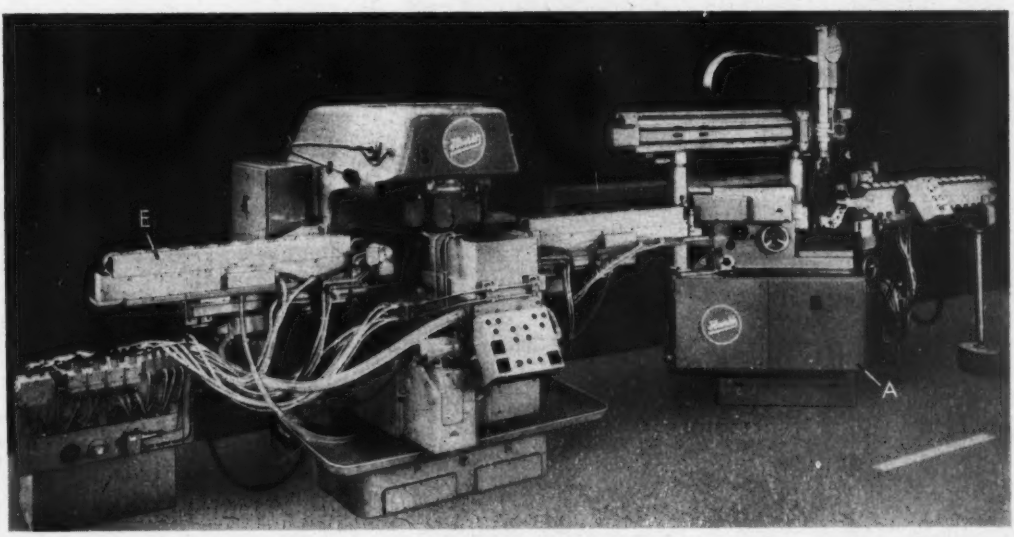


Fig. 1. General view of a link-line set-up incorporating two German-built Hurth machines for chamfering and shaving operations on a gear component

member is of sufficient length to span the gap between it and the loading conveyor of the adjacent shaving machine. When the arm reaches the left-hand end of the bridge, it is automatically stopped and is lowered, to deposit the gear in the conveyor *D*. During its journey, the transfer arm is turned through 90 deg., about a vertical axis, so that the gear is placed in the conveyor *D* on edge, and in a rolling position.

This conveyor leads directly to the Hurth type ZAS 200 shaving machine, seen at the left in Fig. 1, and a pivoting arm picks a gear from the end of the conveyor and holds it while a mandrel is advanced by the work-head. The shaving machine has a large-diameter cutter, which is mounted above the work and is automatically brought into engagement at a pre-set centre distance. The length of the shaving cycle is also predetermined. At the end of the cycle, a special transfer unit at the inner end of the conveyor *E*, Fig. 1, is advanced to a position beneath the work-piece.

This unit incorporates a C-shaped carrier which is pivoted about a horizontal axis, and is raised slightly to support the work when the mandrel is withdrawn. Subsequently, the unit returns to its starting position carrying the gear with it. As the unit comes to rest at the inner end of the conveyor *E*, the pivoting carrier is swung through slightly more than 90 deg., in an anti-clockwise direction, to deposit the gear in the conveyor *E*, once again in a rolling position. Gears can be removed by hand from the left-hand end of the conveyor, or the latter can be arranged to deliver them to another machine, if required.

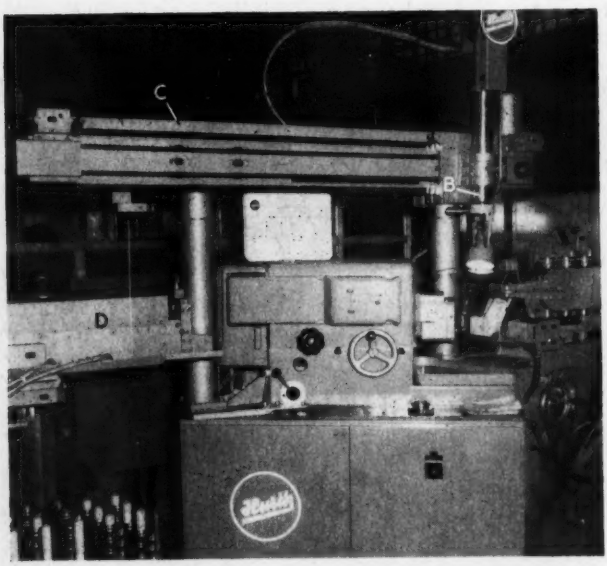


Fig. 2. Close-up view of the Hurth chamfering machine, showing the arm whereby gears are transferred to the feed conveyor of the shaving machine

BOHNER & KÖHLE SECOND-OPERATION SPINNING AND FLOW-FORMING LATHE

Designed and built by Bohner & Köhle, Essinglen, Germany (Press & Shear Machinery Co., Ltd.) for second-operation work on drums for spin-dryers, the spinning and flow-forming lathe shown in Fig. 3 incorporates three radial slides on the headstock, and a fourth slide at the rear of the bed for parting-off or trimming. The headstock spindle incorporates a large-diameter hydraulically-operated collet, and the spin-dryer drum, which has already been formed to the required shape and size, except at the mouth, at a previous operation, is loaded with the open end outwards, as can be clearly seen in the figure.

The rear radial slide, at the right as viewed in the figure, is arranged for longitudinal traverse, on guides which are parallel with the machine spindle, and the transverse movement of the slide is controlled by a hydraulic copying unit. A flat plate template, as at *A*, is employed, and the copying head and stylus can be seen adjacent to it, on the right. A number of successive passes is taken with the rear slide, to produce a reduced-diameter portion at the mouth of the drum.

A radiused shoulder is thus obtained close to the open end of the drum, with a parallel reduced-diameter portion extending therefrom, and before the next stage a steel ring of circular cross-section, as indicated at *B*, is slipped over this parallel portion and is pushed up to the shoulder. Next, the trimming slide at the rear of the bed is advanced, to clean up the end of the drum, and is retracted before the centre radial slide on the headstock is advanced.

This slide has two rollers, and the forward roller is carried on one end of a heavy pivoted arm. The other end of this arm is connected to a double-acting hydraulic cylinder *C*, and when oil is admitted to the head end of this cylinder the piston rod is extended. As a result, the lever

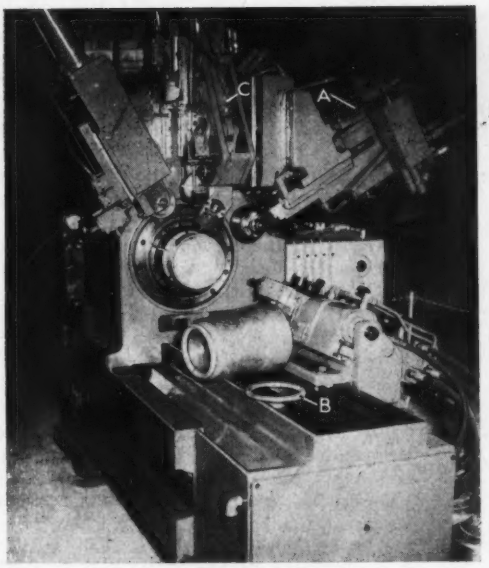


Fig. 3. Bohner & Köhle second-operation spinning and flow-forming lathe

holding the forward roller is pivoted, about a horizontal axis, for spinning the open end of the drum out—and partially round—the steel ring. The other roller on this slide is employed to back up and steady the steel ring while the mouth of the drum is being wrapped around it.

Finally, the left-hand radial slide, is brought in and its roller completes the "wrapping" stage, by turning the flared edge of the drum down, behind the ring. When the cycle has been completed, the ring is almost entirely encircled with metal from the open end of the drum, and an exceptionally smooth and rigid mouth is thus provided for the latter. The drum seen resting on the machine bed is complete, with a steel ring in position.

A fully-automatic cycle embraces the various working stages described above, the operator being required only to load and unload the drum, and to place the steel ring in position at the appropriate time. It may be noted that the machine bed is provided with heavy-section guides on the front wall, so that other slides or attachments can be fitted if required. Pressure oil for the various hydraulically-operated mechanism is supplied by a separate pump and tank unit, which can be seen standing at the rear of the machine.

H.P.E. UNIVERSAL AUTOMATIC MEASURING MACHINE

Developed by High Precision Equipment, Ltd., Bletchley, Bucks., a member company of the Associated Engineering, Ltd., Group, the type AM 7236 universal automatic measuring machine shown in Fig. 4 was originally designed for taking measurements on wind-tunnel models, but with the aid of various attachments it can be employed for inspecting and measuring a wide range of 2- and 3-dimensional workpieces. It should be mentioned that this machine was included among the exhibits on the stand of Ferranti, Ltd., since it is arranged for operation under the control of punched-tape equipment supplied by that company. The massive cast-iron base plate is provided with fixing and levelling screws and has a working surface of 72 by 36 in. Along one long side of this base there is a sub-bed, whereon a saddle can be traversed, and this saddle supports a cast-iron arm, which projects across the base at right-angles to the direction of travel of the saddle. On the arm there is another saddle, which can be traversed to cover the width of the base and

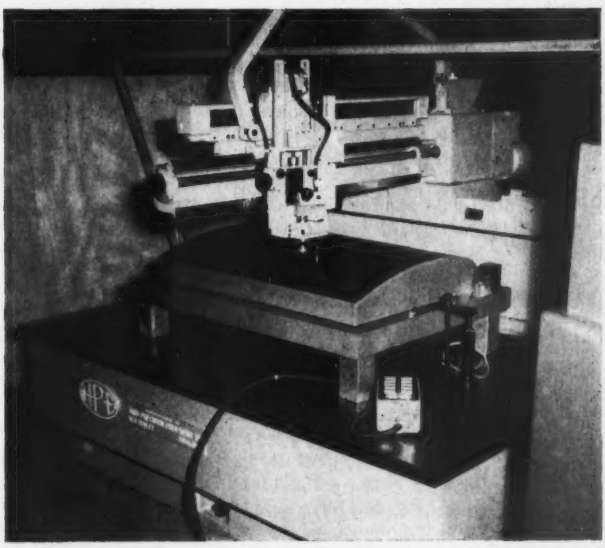


Fig. 4. The H.P.E. type AM 7236 universal automatic measuring machine

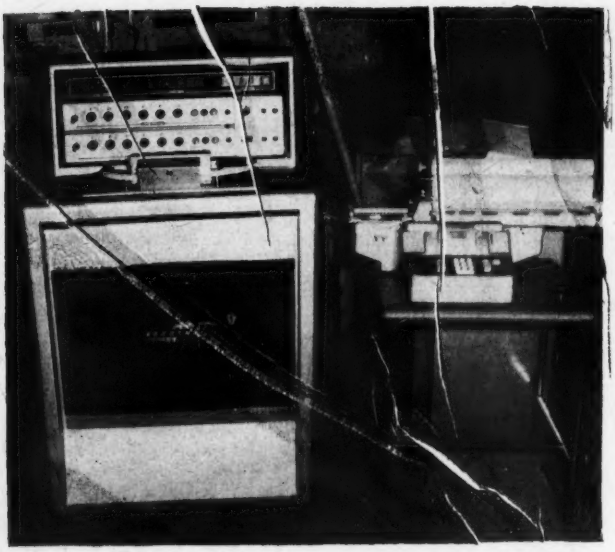


Fig. 5. The Ferranti control cabinet and ADO-X digital printer

serves to carry a probe head. The latter has a vertical movement of 6 in. on guides on the saddle, and the maximum distance obtainable between the tip of the probe and the top surface of the base is 15½ in.

In operation, the probe head is moved to preselected points above the surface of the work, by combined movements of the saddles on the arm and the sub-bed, and at each selected point it is lowered automatically until the tip of the probe makes contact with the surface to be measured. Immediately contact is made, the amount by which the probe has been lowered in relation to a datum in the horizontal plane is registered electrically, and in this manner the complete surface of the work can be covered and height readings obtained at the preselected points.

The movements of the arm longitudinally, and of the probe head saddle transversely, are controlled by a Ferranti point-to-point system, and the control cabinet for this equipment is shown in Fig. 5. Successive co-ordinate positions for the probe head can be obtained by manual settings on a series of dials, or automatically by means of punched paper tape. The manual setting dials are arranged in rows in a panel, the upper row providing for longitudinal dimensions, and the lower row for transverse dimensions. Immediately above each knob there is a small circular window, and the knob is turned until the required digit appears in this window. Recirculating ball nuts and screws, driven by servo motors under the control of the Ferranti equipment, are employed for moving the saddle on the sub-bed, also the probe head on the arm, and as the machine members come to a stop their positions in the longitudinal and transverse planes are indicated on display tubes above the setting dials. With this arrangement, the operator can readily check that the probe is in the required position.

The probe head is now lowered automatically, to contact the surface of the work, and the distance by which it has been lowered is indicated on a third group of display tubes, to the right of those for the longitudinal and transverse movements. The equipment can also be arranged to produce a print-out of successive movements, with the aid of the ADO-X digital printer seen at the right in Fig. 5. This unit is connected to the electrical circuit of the control cabinet and automatically prints the positions of the probe head in the *X* and *Y* axes, also the corresponding dimensions in the *Z* axis.

The H.P.E. machine can be used for a variety of other applications. For example, the probe head can be replaced by a centre punch attachment, and with the aid of a punched-tape incorporating the required *X* and *Y* data, flat sheet templates can be marked out. Alternatively, a flat template can be mounted on edge on the table, and the profile can be checked. For this application, successive increments of movement of the probe head in either the *X* or *Y* axis are required, according to the position of the template on the table, and for each position a *Z* axis reading is taken, and recorded.

For checking the positions of a series of holes in a workpiece, the probe head is removed and a dial gauge is substituted. The gauge is moved to each co-ordinate position, in turn, and is then lowered into the hole and rotated to check the position of the latter. For checking the positions of small-diameter holes, a microscope head is provided.

G.S.P. TYPE 84-2 AUTOMATIC GEAR-HOBBING MACHINE

Introduced by Ateliers G.S.P., Courbevoie, Seine, France (Stanhope Machine Tools, Ltd., 12/14 Wigmore Street, London, W.1), the type 84-2 automatic gear-hobbing machine shown in

Fig. 6 is provided with a rotary-type work loading and unloading equipment, and is shown set up for cutting single-helical teeth on two blanks at a time. It will accept gears up to a maximum diameter of 9·84 in., and will cut teeth up to a face width of 5·90 in., and 5 module.

As can be seen in the figure, the bed is a massive L-shaped casting with guides for the work saddle which supports the loading and unloading equipment. On the inner vertical face of the L-shape there is a horizontal pivot, about which a heavy disc-shaped casting can be swivelled, and be clamped in the required position. The outer face of this casting has flat slideways, on which the hobbing head is arranged to rise and fall, and there is provision for axial movement of the hob spindle, so that "shift" can be applied. The swivelling casting, which carries the hob spindle, is set to the required angle for cutting helical gears up to 45 deg. right- or left-hand by reference to a precision scale, and this operation is facilitated by optical equipment. When plain spur gears are to be cut, the swivel casting is set with its slideways in the vertical position.

Drive to the hob spindle is taken from a 7·5-h.p. motor, which is mounted parallel to the hob slide, at one end, and with this arrangement it has been possible to eliminate bevel gears from the transmission. A range of twelve feeds is provided for the hob slide, from $\frac{1}{16}$ to $3\frac{15}{16}$ in. per min., changes being made by pick-off gears, and for rapid approach and withdrawal from the work the speed is 112 in. per min. The slide is moved by a screw and nut and is counterbalanced hydraulically.

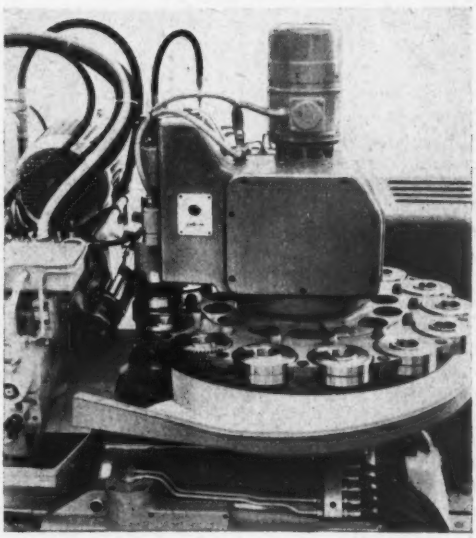


Fig. 7. Close-up view of the working zone of the G.S.P. type 84-2 gear hobber

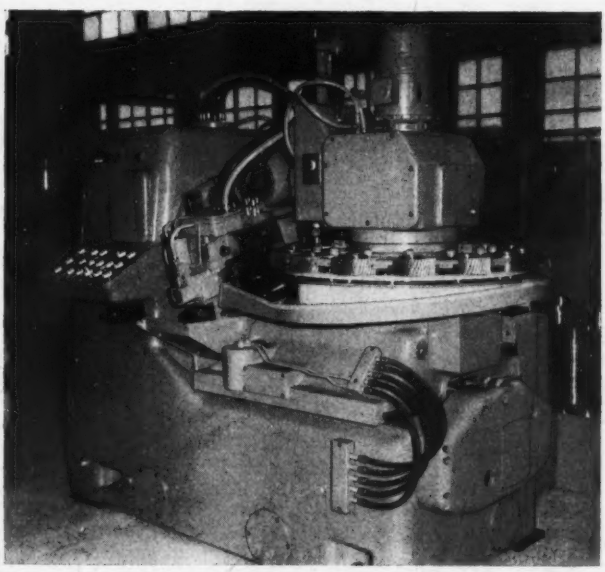


Fig. 6. The G.S.P. type 84-2 automatic gear-hobbing machine, arranged for automatic loading and unloading

The work saddle slides on flat and vee ways, and there is an additional single dovetail guide at the rear, and in the vertical plane, which engages with a slideway on a raised portion of the bed. This guide is provided with a tapered gib and avoids any tendency for the saddle to "tip" under the pressure of the cut. The saddle has a circular central portion, in which are housed the bearings for the indexing work carrier, and at the lower end of the vertical work spindle is mounted the master wormwheel. A close-up view of the working area of the machine is given in Fig. 7, where the work spindle is clearly visible. A number of blanks and cut gears can also be seen in the carrier plate, which is indexed in an anti-clockwise direction, as viewed from above. The gears are held in part-circular cut-outs in the carrier, and slide around on an

annular plate. At the working position, this plate has a cut-out, and gears in this position drop through the cut-out on to a register provided on the upper end of the work spindle.

Immediately above the spindle, and coaxial with it, there is a hydraulically-operated mandrel, which is brought down to engage the bore of the work, and to clamp it to the spindle. At the end of the automatic cycle, the mandrel is raised and provision is made for lifting the gears slightly to clear the register on the work spindle. At the next indexing movement of the carrier plate, the gears are removed, and fresh blanks substituted. The hydraulically-operated mandrel mentioned above is carried on a head member which projects from the centre of the carrier plate, as can be clearly seen in Fig. 7. This head incorporates change gears for the indexing drive to the work carrier, also the motor for this motion.

All controls for the machine, also for setting the automatic cycle, are grouped on a desk-type panel, projecting from the bed at the left, and the operator is required only to load and unload the gears from the work carrier. Alternatively, the carrier can be arranged to accept blanks delivered from a preceding machine by means of a conveyor.

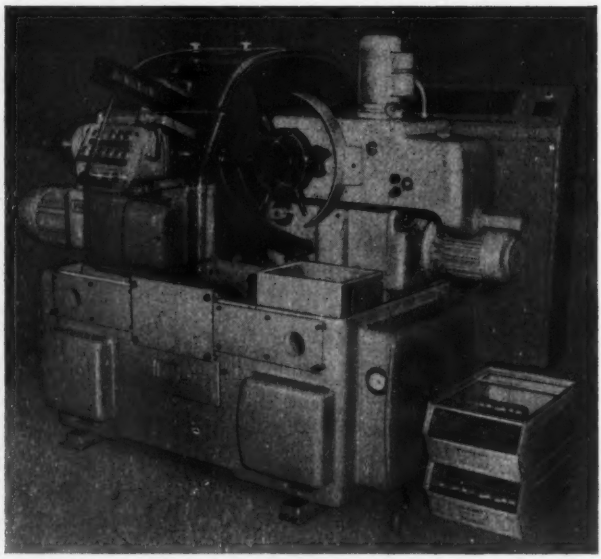


Fig. 8. German-built Pfaff type R2-b programme-controlled automatic turret lathe

PFAFF AUTOMATIC TURRET LATHE AND WORK FEEDING UNIT

The new type R2-b turret lathe for chucking work, which has recently been introduced by G.M. Pfaff A.G., Machine Tool Division, Kaiserlautern, Germany, can be operated on a semi-automatic cycle. Alternatively, a wide variety of fully-automatic cycles can be obtained by means of peg-board control equipment housed in a separate floor-mounted cabinet. Automatic work-loading equipment can be fitted which enables the lathe to be maintained in continuous operation. The lathe is shown in Fig. 8 fitted with automatic loading equipment for handling parts up to 2⅝ in. long, and a close-up view of the working zone is given in Fig. 9.

With this equipment, workpieces to be machined are loaded into an inclined magazine chute mounted on the headstock, and the leading piece is held by a fixed and a spring loaded jaw on the swivel head *A*. At each cycle, the head *A* is swung downwards to bring the component into line with the chuck, as shown, and an arcuate portion prevents other components from falling from the chute. The workpiece to be machined is now advanced into the chuck by a pusher on the tool turret, and when the jaws have been closed, the head *A* is returned to its starting position, and turning begins. At the end of the machining cycle, the chute *B* is swung upwards to the position shown, to receive the completed component when the chuck jaws have been opened.

For longer components, work-handling equipment of a different design can be supplied. This equipment incorporates a bell-crank lever mounted on the headstock, which has gripper jaws at the ends for holding workpieces. At the completion of a working cycle, the finished piece is held by the gripper jaws at one end of the lever, and the chuck is then opened. At the same time, a fresh workpiece, in a magazine at the front of the lathe, is grippped by the jaws at the other end of the lever. The latter is now swivelled on a horizontal axis, with the result that the completed workpiece is delivered to another magazine at the rear of the lathe, and the fresh part is brought into line with the chuck. At the end of the loading operation, the lever is swivelled through 45 deg. and then raised, so that its ends are held clear of the chuck and cutting tools while turning is in progress.

Interchangeable turrets of 8¾ in. diameter, with six and eight tool positions, can be supplied for the lathe. When machining has been completed on a particular batch of workpieces, the turret and cutting tools can be readily removed from the machine as a single unit, and stored. Equipment can be supplied for pre-setting cutting tools before a turret is mounted on the machine. The turret has a maximum travel of 5⅞ in. on hardened bed-ways, which are automatically lubricated, and 9 feeds from 1$\frac{13}{32}$ to 8⅞ in. per min., also rapid power traverse at rates of 75⅝ and 159⅜ in. per min. are obtainable, the drive being taken from a 2-h.p. motor, through gearing and a screw. A separate motor is provided for indexing the turret. A maximum distance of 11¼ in. is obtainable between the nose of the headstock spindle and the periphery of the turret.

Mounted in high-precision anti-friction bearings, the headstock spindle is driven by a pole-changing motor of 2½/3¼ h.p., which is fitted with a brake, through gearing and multi-disc electro-magnetic clutches. Spindle speeds from 315 to 2,400 r.p.m. are available in four ranges, and a maximum of four speeds can be brought into use automatically by means of the electro-magnetic clutches, during a programme-controlled cycle. Guideway units to take front and rear cross-slides can be mounted on the headstock. The cross-slides have a maximum movement of 1¾ in., and in-feeds from $\frac{31}{32}$ to 20⅝ in. per min. are derived from the spindle driving motor. A maximum diameter of 3$\frac{5}{16}$ in. can be turned by cutting tools mounted in the turret, and of 5½ in. by the cross-slide tools, and diameters up to 7⅜ in. can be swung over the bed-ways.

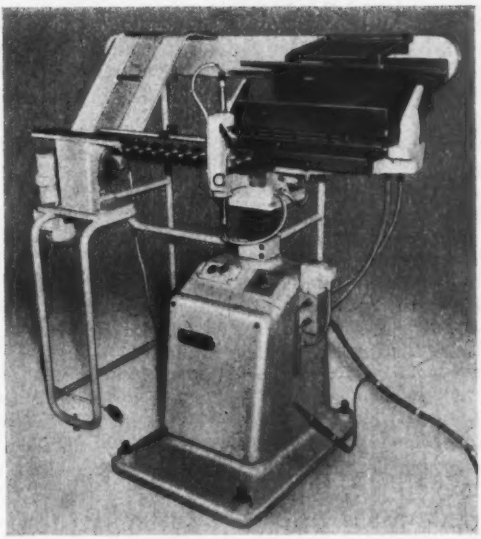


Fig. 10. This Pfaff unit is intended for use in conjunction with a centreless grinder, for example

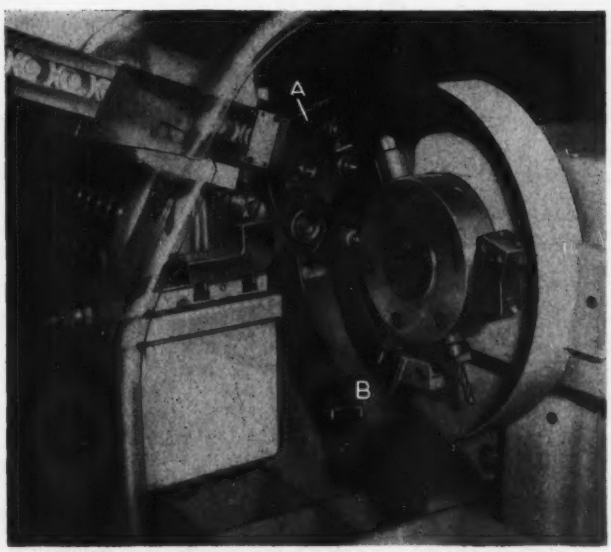


Fig. 9. Close-up view of the turret and work-loading equipment on the Pfaff turret lathe

The unit shown in Fig. 10 has recently been introduced by the company for feeding cylindrical workpieces in an axial direction, and may be used in conjunction with a centreless grinder or a roll-type straightening machine, for example. It will handle workpieces from $\frac{3}{16}$ to 1$\frac{3}{16}$ in. diameter with lengths ranging from 4 to 16 in. Workpieces are loaded into an adjustable, inclined chute, and are passed, one at a time, into a V-shaped trough, by way of an escapement mechanism which is operated by air cylinders. The part in the trough is then moved to the left by means of a number of permanent magnetic, diabolo-shaped rollers which are continuously driven by an electric motor. During the feed movement, the workpiece interrupts a beam of light from a lamp unit mounted on the bracket *C*, which is positioned between the second and

third rollers from the right-hand end. When the right-hand end of the part has been moved clear, the light rays energize a photo-electric cell, which operates the air cylinders, with the result that another piece is passed through the escapement mechanism. In this way, workpieces are fed, one after another, to the associated machine.

The working speed of the magnetic rolls can be varied in six steps, to give traversing speeds for the work from 6 to 44 ft. per min. The entire unit can be adjusted vertically on the base, and the maximum and minimum heights of the centre line of the work above the shop floor are 44¾ and 40⅝ in. For demonstration purposes at the Exhibition, workpieces were returned from the left-hand end of the unit to the inclined chute at the right-hand end, by way of an inclined and a horizontal conveyor, as shown, but it will be understood that this equipment is not normally supplied.

S.A.S.S. RADIAL DRILLING MACHINES

The radial drilling machine shown in Fig. 11 is the intermediate size in a range of three built by the Italian firm of S.A.S.S., Turin, and is known as the TRP 3000. It has maximum and minimum drilling radii of 133 and 32¾ in., and the corresponding figures for the larger and smaller machines in the range—designated TRP 3500 and 2500—are 152½ and 32¾ in., and 113 and 32¾ in. The drilling head has a traverse on the arm of 100¾ in., and the latter has a vertical movement of 52½ in.

As can be seen from the figure, the column is mounted on a saddle, and there is provision for power traverse on a cast iron bed with wide flat guiding surfaces. The motor for this motion is mounted on the saddle, and drive is transmitted to a pinion which meshes with a rack secured to the bed. By the addition of further sections, which are tenoned and bolted end to end, the bed can be extended to any required length. Alternatively, the machine can be supplied with a conventional base-plate, and the minimum and maximum distances between the latter and the nose of the spindle are 23¾ and 99 in.

Each of the machines in the range has a 29½-in. diameter column, and the arm is raised and lowered by a screw which is driven by a motor mounted at the top of the column. The spindle has a No. 6 Morse taper and is carried in a 5⅞-in. diameter quill, which has an axial travel of 23⅝ in. There are 24 spindle speeds, ranging from 13 to 1,050 r.p.m., and 18 feed rates, from 0·0024 to 0·118 in. per rev. It will be noted that a swivelling seat for the operator is secured to the underside of the drilling head, which is provided with panels whereby all functions of the machine can be controlled, and a pendant box is also provided.

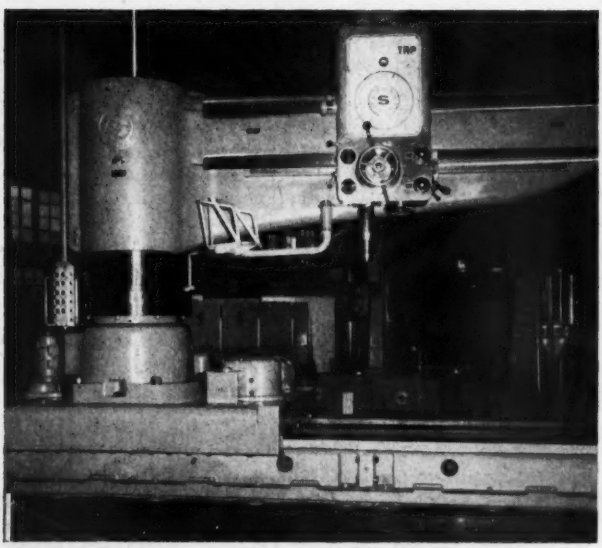


Fig. 11. This S.A.S.S. travelling-column radial drill is the intermediate size of a range of three machines

Typical working capacities for all three machines are as follows: drilling from the solid in cast iron and steel up to 6 in. and 4¾ in. diameter, respectively; boring in cast iron and steel up to 8¾ and 7⅛ in. diameter; and tapping in cast iron and steel up to 6 in. and 5 in. diameter.

Features of the machine include power swivelling of the arm, automatic clamping of the arm after vertical adjustment on the column, power rapid traverse movement of the head on the arm, pre-selection of spindle speeds, feed rates, and depth stops, and hydraulic braking of the spindle.

EXPORTS OF LATHES, of the capstan and turret types, during the nine months ending September 30, 1961, reached a total value of £2,184,314, as compared with £1,553,328 for the same period of the preceding year. Other types of lathes produced up to September 30, 1961, were valued at £3,189,642.

Hird-Brown Super Cub Photo-electric Timer

Hird-Brown, Ltd., 244 Marsland Road, Sale, Cheshire, have introduced an improved version of their photo-electric equipment for recording the time that elapses during movement of a body between two pre-determined points, which may be used for method studies, and investigations of automatic machinery. With this equipment, separate photo-electric cell units, at either end of the path travelled, serve to operate two conventional stop-watches simultaneously, to provide duplicate records of the time occupied by the movement. A single watch can be used if a check is considered to be unnecessary, and the equipment is suitable for operation at temperatures between −40 and 45 deg. C.

The photo-electric units measure 2 in. diameter by 5 in. long, and together weigh 2 lb. They can be set at distances up to 3 miles from the common control unit, to which they are connected by 2-core cable, and they are operated by separate light-source units. If required, the photo-electric cell and light units can be supplied with tripod stands as shown in the accompanying illustration.

Seen in the centre of this figure is the self-contained, battery-operated control unit which is fully transistorized, and incorporates a 3-position, neutrally-biased switch, whereby the cell units are brought into use individually, shortly before it is anticipated that the associated light beams will be interrupted. With this arrangement, there is the minimum risk of false readings being obtained, due to the beams being interrupted accidentally. Clamps for the stop watches are provided on top of the control unit, which is housed in a steel case measuring 9 by 6 by 4 in. and weighs 10 lb.

Known as the Super Cub, the improved equipment incorporates a monitoring system whereby a white signal lamp, on the control unit, flashes when the photo-electric cells are operating correctly, and this provision considerably facilitates alignment of the associated cell and light source units during setting up. A Traffolite panel has been added, as insulation against stray magnetism, and the control unit has been modified for operation by means of three Ever Ready type PP7 batteries, which are available in many parts of the world.

Hird-Brown Super Cub battery-operated photo-electric timing equipment, with separate light-source units. A flashing lamp facilitates aligning the photo-electric transmitters and receivers

W. & M. 2-speed Drive for a Power Press

The accompanying figure shows, diagrammatically, a 2-speed drive arrangement for a power press, which has been developed by Wilkins & Mitchell, Ltd., The Green, Darlaston, South Staffs.

From the flywheel *A*, drive to the ram may be taken by an electro-pneumatic clutch and the high-speed pinion shaft *B*, to provide rapid traverse movements during the non-working portions of the cycle, or by way of reduction gearing, a second electro-pneumatic clutch, and the low-speed pinion shaft *C*. At the beginning of the working cycle, the first clutch is energized, with the result that the shaft *B* is driven at the same speed as the flywheel for rapidly traversing the ram downwards. At a predetermined point in the travel of the ram, the first clutch is de-energized and the second clutch is engaged. Drive is then taken by way of the reduction gearing and the shaft *C*, to provide the required ram speed for the working part of the stroke. Upon

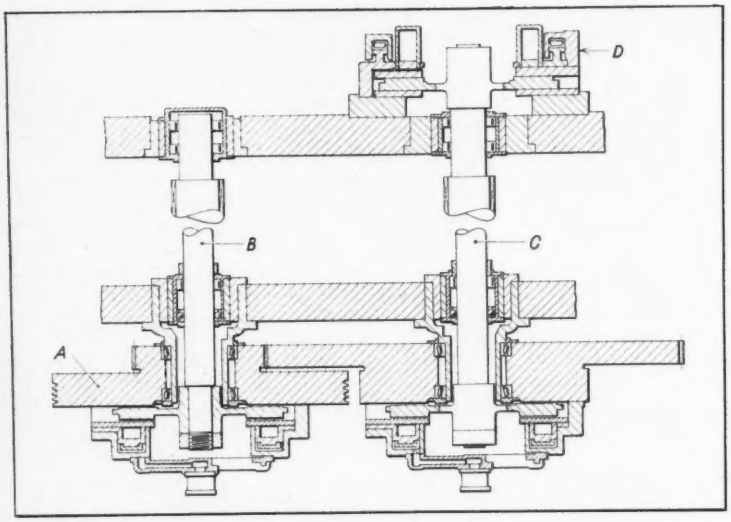


Diagram of the Wilkins & Mitchell 2-speed drive for a power press

completion of the working stroke, the first clutch is again energized and the second clutch is de-energized, with the result that the ram is rapidly returned, and the shaft *C* runs idly. When the ram has been brought to the top of its stroke, it is held by an electro-pneumatic brake indicated at *D*, which is applied to the shaft *C*, and the first clutch is disengaged.

Magnu-Blast Vapour Peening Machine

The accompanying illustration shows the Magnu-Blast vapour peening machine, which has been introduced recently by Magnus Chemical Co., Ltd., Salisbury Road, Industrial Estate, Uxbridge, Middx., and is intended for improving the physical properties of the surface layers of a wide variety of components, also for cleaning. It is designed primarily to employ a slurry comprising water and lead-free glass beads, which are smaller than 170 mesh (American), and this media ensures that no metal is removed from the surfaces of the work during peening. The slurry is atomized and discharged by compressed air from the hand-operated blasting gun, and it is claimed that maintenance costs and the risk of breakdown are virtually eliminated since a pump is not employed.

Illuminated by two externally-mounted fluorescent tubes, the blasting compartment measures 35 by 28 by 28 in., and incorporates a heavy expanded-metal platform. If required, a swivelling work-table can be supplied at extra cost. Loading is effected through a door at one side, which is sealed by an encased sponge rubber gasket and is secured by means of quick-acting, lever-operated locks. Heavy-duty gloves secured to the front of the unit provide for the manipulation of the work, and the gun during the progress of blasting, and the supply of compressed air to the latter is controlled by a foot-operated valve. A heavy-duty, air-operated windscreen wiper is provided for the 20- by 9-in. window at the front of the unit, and vapour which is released into the compartment during blasting is removed by an extractor fan, to ensure that the work can always be readily observed. From this fan, the vapour is

Magnu-Blast vapour peening machine

passed to a cyclone separator, and the recovered slurry is thence returned to a reservoir tank, which incorporates an agitator and has capacity for a mixture comprising 1 gal. of water and 4 lb. of beads.

It is stated that significant savings have been obtained by the use of the Magnu-Blast vapour-peening process for cleaning moulds for plastics materials, also for cleaning moulds for rubber, during production runs.

Metalock Repair Workshop

The accompanying illustration is a general view of the central workshop that has been established at Bow by Metalock (Britain), Ltd., Grand Buildings, Trafalgar Square, London, W.C.2, for carrying out repairs to major machinery components by their cold keying process. From their wide experience of repairing such parts on site, the company came to the conclusion that repairs could often be carried out more effectively in a central workshop. During recent months, a variety of components—including pump casings, gears, lathe aprons, press platens and diesel-engine heads—have been repaired at Bow, and the time for such repairs does not usually exceed a week. Particularly effective methods have been developed for the cold repair of internal combustion engine components.

General view of the central workshop established at Bow by Metalock (Britain), Ltd., for the cold repair of broken machinery components

AMF Elapsed Time Indicator

Leland Airborne Products Division of American Machine & Foundry Co., who are represented in this country by AMF, Ltd., 4 to 6 Saville Row, London, W.1, have introduced the Time Totalizer unit here illustrated, which indicates elapsed hours of operating time. It incorporates a mercury coulometer operated by an integral electrical network which compensates for temperature differences and supply voltage variations, and the full scale range of the instrument is 1,000 hrs.

AMF Time Totalizer elapsed time indicator which has a full-scale range of 1,000 hours

Two basic types are available for operation on a.c. supplies of 105/125 and 200/250 volts, and with frequencies ranging from 50 to 2,400 cycles per sec., and d.c. supplies of 24/32 volts, and the power consumption is approximately 0·5 watt. These units are suitable for use in a temperature range from −35 to +71 deg. C. and are stated to be accurate to ±6 per cent over the full temperature, voltage and frequency range. The overall dimensions of the indicator are 1 in. by $\frac{9}{16}$ in. by $2\frac{3}{16}$ in.

RANPLAN STANDARDIZED DRAWING STORAGE UNITS. James H. Randall & Son, Ltd., Paddington Green Works, London, W.C.2, have introduced a new range of Ranplan steel storage units for drawings. Each unit has 14 trays, 1-in. deep, and an overall height of 22 in. The width and the front to back dimensions can be made to suit requirements, and trays can be supplied with two or four compartments to take smaller drawings. The cabinets have a stove-enamelled finish, and a simple retaining lug on the back of each unit permits safe stacking.

Renault Machine Tool Developments

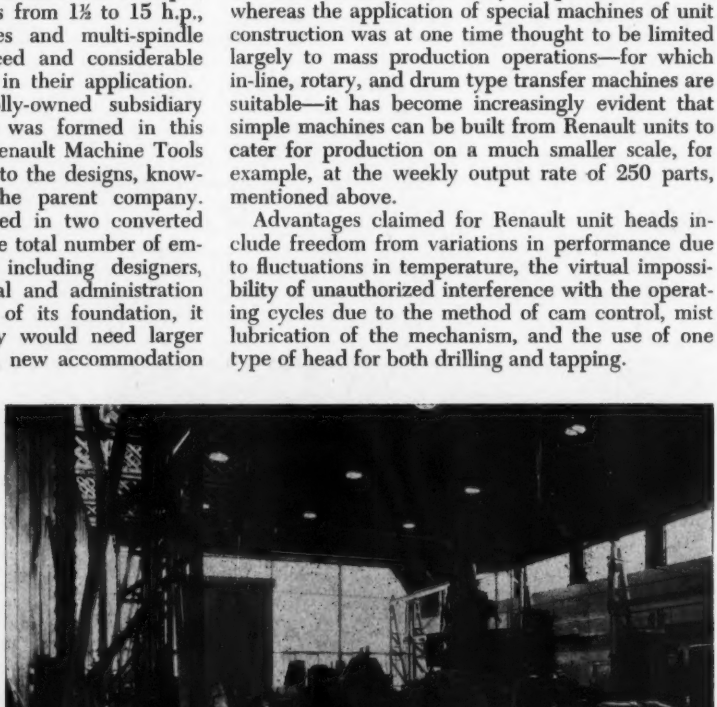
For many years, Regie Nationale des Usines Renault, the well-known French motor vehicle manufacturers, have built machine tools, mechanical handling equipment and automatic assembly machines for use in their factories, and reference to such equipment has been made from time to time in MACHINERY. In addition, the Renault organization has built machines for use in factories making a diversity of products in various parts of the world. An extensive system of standardization of machine elements—for example, electro-mechanical unit heads from 1½ to 15 h.p., columns, bases rotary tables and multi-spindle adapters—has been introduced and considerable experience has been gained in their application.

In August, 1959, a wholly-owned subsidiary of the French organization was formed in this country under the name of Renault Machine Tools (U.K.), Ltd., with full access to the designs, knowledge, and experience of the parent company. Headquarters were established in two converted houses in Shrewsbury, and the total number of employees was originally 16, including designers, draughtsmen, and commercial and administration staff. Within three months of its foundation, it was clear that the company would need larger premises, and by July, 1960, new accommodation had been arranged at Monkmoor Road, Shrewsbury, and the necessary provisions with regard to assembly workshops, cranes, and offices had been made. The drawing office now has a staff of 22 designers and draughtsmen, also a number of apprentices, and since the office is in close proximity to the workshops, liaison between the design staff and the works is facilitated. At present, the total number of employees at the Monkmoor Road works exceeds 70.

During the past year, 16 special machines have been designed, built and delivered to customers in the United Kingdom, as well as several electro-mechanical unit heads, and the company has work in hand until the autumn of 1962. Design and construction of the machines has been facilitated by the close-co-operation that exists between the French and British companies, and the flexibility and versatility of the Renault system are indicated by the fact that machines have been designed and built to handle components at output rates from 1,000 per hour to 250 per week (40 hours).

In this connection, it may be pointed out that whereas the application of special machines of unit construction was at one time thought to be limited largely to mass production operations—for which in-line, rotary, and drum type transfer machines are suitable—it has become increasingly evident that simple machines can be built from Renault units to cater for production on a much smaller scale, for example, at the weekly output rate of 250 parts, mentioned above.

Advantages claimed for Renault unit heads include freedom from variations in performance due to fluctuations in temperature, the virtual impossibility of unauthorized interference with the operating cycles due to the method of cam control, mist lubrication of the mechanism, and the use of one type of head for both drilling and tapping.



Part of the assembly shop at Renault Machine Tools (U.K.), Ltd.

Richards Type SB 35 Horizontal Boring Machine with Tape Control

George Richards & Co., Ltd., Broadheath, Altrincham, Cheshire, a member company of the Staveley Industries, Ltd., Group, have recently supplied a type SB 35 horizontal boring, drilling and milling machine equipped with tape control to Goss Printing Press Co., Ltd., Preston. The machine is shown in Fig. 1, and the tape control system is applied to the vertical movements of the spindle head and the transverse movements of the work-table.

The machine is generally similar to the Richards table type, but certain special provisions have been made to permit full advantage to be taken of the accuracy of the positioning system. Outboard supports have been provided for the saddle unit, whereon the table slides, in order to prevent the introduction of errors due to deflection of the saddle at the extremes of table traverse. The table is fully supported over the entire length of its traverse, and the outboard supports move on slideways that are grouted into the machine foundations, on either side of the bed. Automatic, hydraulically - actuated clamping arrangements are incorporated for the table on the saddle guideways and for the spindle head on the column guideways. Manually-controlled hydraulic clamping is provided for the saddle on the longitudinal guideways of the bed. In addition to the automatic co-ordinate positioning system, the machine is fitted with Hilger & Watts optical measuring equipment, with precision engraved steel scales and projection viewing screens, whereby settings can be made to an accuracy of 0·0005 in.

In accordance with the company's normal practice, the spindle head is a self-contained unit, and is fully counterbalanced by weights within the column. The main spindle sleeve is of forged steel and is mounted in preloaded taper roller bearings. Similar bearings are provided for the 3½-in. diameter inner traversing spindle, which is made from nitrided steel and precision ground. The machine was supplied without an automatic facing head and slide, at the customer's request. A total of 27 spindle speeds is available, ranging from 7 to 1,250 r.p.m., and the maximum traverse of the spindle is 36 in. Feed rates for the spindle horizontally, and the spindle head vertically, are steplessly variable from 0·05 to 20 in. per min., and rapid power traverse is at a rate of 35 in. per min. for both motions. A fluorescent lighting unit is built into the end of the head unit facing the work.

The main table measures 66 by 42 in., and is fitted with a 48-in. square, indexing table. Provision is made for locking the indexing table in the main 90-deg. settings, and for clamping it at any intermediate position. The table-saddle

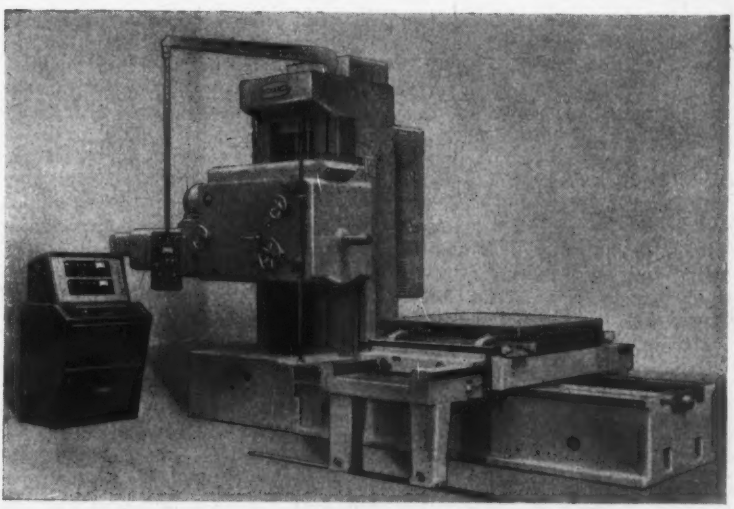


Fig. 1. Richards type SB 35 horizontal boring, drilling and milling machine which has a tape controlled positioning system developed by the Staveley Group Research Department, and provides for vertical movements of the spindle head and transverse movements of the table

assembly has maximum traverse motions of 51 in. longitudinally and 54 in. transversely, and the feed and rapid traverse rates are the same as those for the spindle head.

A boring stay of 2-piece construction is fitted to the machine, and the main stay, which carries the boring bar bearing housing, can be removed from the bed block. The top surface of the latter member is in the same plane as the main table surface, and can be used to support extra-long workpieces. A maximum distance of 99 in. can be obtained between the spindle head and the boring stay.

All motions of the machine can be controlled from the main pendant panel, and an emergency stop plunger is incorporated in the bottom of the panel. Spindle speeds are selected by a rotary switch on the panel, through electro-magnetic multi-disc clutches in the spindle head, and speed changes can be effected rapidly and smoothly while the spindle is running. It may be mentioned that, as an alternative, steplessly variable spindle speeds can be provided by means of a Ward Leonard system, the speed then being controlled by means of a rotary potentiometer on the pendant panel.

For the steplessly variable feed rates, there is a rotary potentiometer with a large dial, calibrated in in. per min., and a meter on the pendant panel, operating in conjunction with the speed control system, indicates the feed rate in terms of in. per rev. All feed changes can be made while the machine is running. Rapid power traverse motions in all directions are engaged by push-buttons on the pendant. The rapid traverse and feed drives are powered by constant speed a.c. and variable speed d.c. motors respectively, which are flange-mounted on a self-contained gearbox at the rear of the bed.

A main motor of 15 h.p. is provided for the spindle head, and this unit has a fully-automatic lubrication system, which is interlocked with the motor and is brought into operation before the main drive is started. The bed slideways are constantly lubricated by a power-operated system.

CO-ORDINATE POSITIONING ARRANGEMENTS

The co-ordinate positioning system applied to the machine has been developed by the Staveley Research Department (which formed the subject of an article in MACHINERY, 99/1309—7/6/61). Provision is made for manual pre-selection of the positions of the spindle head and table, and for automatic positioning of these members by means of a perforated paper tape. A more detailed description of the system will be given later in this article, but it suffices here to say that the position of the table or head is measured by means of a coarse-pitch optical reflection grating. This grating is scanned by a reading head, which transmits an electrical signal of modified sine-wave form. The phase of this waveform remains in coincidence with a master reference signal as long as the machine member remains stationary. When movement takes place, there is a phase shift between the two signals, and measurement of shift is employed to determine the displacement of the machine member. One complete phase shift, through 360 deg., is equal to a displacement of 0·010 in., and the arrangements are such that the displacement is measured by counting the number of complete changes of phase, and the fraction of a phase change.

Fig. 2 shows the control console, also seen at the extreme left in Fig. 1. The upper part of the console provides for manual setting and read-out, and incorporates two sets of controls and indicating units. In each set there are four electronic number tubes and a meter. Between the second and third number tubes there is a small signal lamp which represents the decimal point, and the meter has a scale calibrated from zero to 0·010 in. with 0·001-in. main divisions and 0·0005 in. sub-divisions. Movement of the meter needle over the full scale represents a complete phase shift of 360 deg., so that the tens, units, tenths and hundredths of a given movement are indicated on the number tubes, and the thousands and half-thousandths of an inch, on the meter.

Below the number tubes and the meter there are knobs for manual pre-setting of distances to be traversed. As each knob is turned, figures appear in a small window above it to show the setting. At the extreme left of each set of controls there is a signal lamp with an arrow to indicate the direction of motion. A red signal lamp, at the left of the upper unit of the console, is illuminated if the movement, as indicated by the number tubes and the meter, does not correspond to the pre-set dimension. This lamp, it may be noted, is illuminated continuously when the machine is being operated under tape control.

Tape control equipment is housed in the lower part of the console. Access to the tape reader, for insertion of the punched paper tape, is gained by way of a rectangular aperture, which is closed by a hinged transparent plastics cover, as seen in the illustration. To the left of this aperture there are two switch knobs, one of which serves for selecting tape or manual control, and the other, transverse or vertical motion (when the system is being operated manually). At the right-hand side of the aperture there are two number

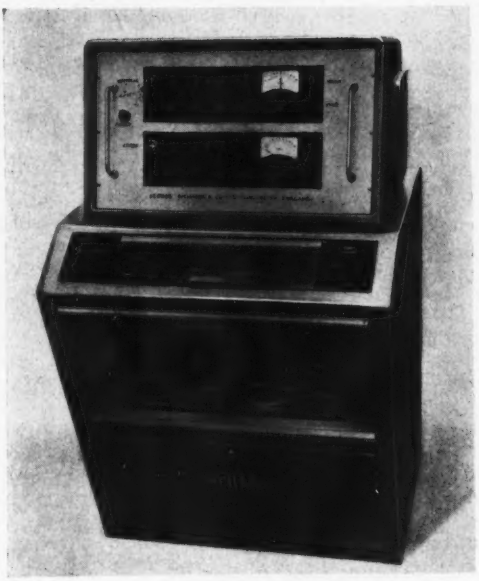


Fig. 2. The console containing the tape control equipment for the Richards machine. Developed by the Staveley Research Department, the positioning system can also be operated manually, and the distances traversed are indicated by electronic number tubes and meters

tubes and a rectangular signal lamp. The number tubes indicate the operation sequence number at the start of each movement cycle when tape control is being used, and the signal lamp is lit to show that the cycle has been completed and the machine is ready for the cutting operation.

Below the tape reader there are two plastics containers for the tape, which are accessible on opening a large transparent plastics hinged cover. The tape containers themselves are of interest, and each consists of a shallow box, which is completely closed except for rectangular openings in the top and bottom. When the container is in the working position, it is located by the engagement of the bottom opening with a wedge-shaped block, secured to the floor of the chamber. Tape is drawn out of the upper opening, of one container, and after it has been fed through the reader, it is directed through the upper opening of the other container. The tape stacks itself in layers in this container as the cycle proceeds, with the leading end at the bottom. If it is required to repeat the cycle, it is only necessary to change over the empty and full containers, invert the latter and draw the leading end of the tape through the opening which is then uppermost. By this simple arrangement, tangling of the tape is eliminated and the repetition of the machining cycles is greatly facilitated.

The electronic circuit is built up on a series of printed circuit boards for ease of maintenance. These boards are arranged in a horizontal stack in the lower part of the console, and are readily accessible through doors at the rear. The boards are separated by spacers, and any board may be withdrawn when a single clamping screw has been slackened off.

Paper tape is employed for single workpieces, and more permanent tape for batches of workpieces. There is a continuous line of small perforations for feeding the tape, and up to five holes may be pierced across the width, on a standard Creed machine. Two of the five holes are used to indicate each digit, and a complete row of five holes is punched to mark the start of each dimension group. Under tape control, the transverse movement of the table takes place first, and the table is then locked in position, before the vertical movement of the spindle head is initiated. Each unit is moved at the rapid traverse rate to approximately 0·140 in. past the required position, and it is then moved in the reverse direction at a slow rate until that position is reached. It is claimed that the system permits repetition of settings to an accuracy closer than ±0·0002 in., and that the absolute accuracy from datum is ±0·0005 in. over the first 12 in. of movement, ±0·0007 in. over the second 12 in., ±0·0009 in. over the third 12 in., and ±0·0011 in. over the fourth 12 in.

STAVELEY MEASURING SYSTEM

The measuring and control system employed on the Richards machine has been developed by the Staveley Research Department, and the equipment has been built by W. H. Smith & Co. (Electrical Engineers), Ltd., a member company of Staveley Industries, Ltd., Stainless iron reflection gratings, with 100 lines per in., are used for determining the distances traversed by the spindle head and table, in conjunction with photo-electric reading heads. These gratings, it may be mentioned, are supplied by Technicolour, Ltd.

Displacement of a reading head relative to its associated grating is converted into a phase displacement of an a.c. electrical signal in relation to a reference signal, the phase of the latter being itself adjustable by means of a datum setting control. Both the reading head and the datum setting control produce the required phase-adjusted signals by selecting and mixing appropriate proportions of

the four outputs of a fixed-frequency, 4-phase, square-wave generator, and suitably filtering and squaring the resulting outputs.

Each reading head incorporates four sections of transmission grating (also with 100 lines per in.), which form what is known as a 4-part index. Light from an electric lamp is projected on to the reflection grating, through the transmission gratings of the index, and when reflected back by the polished lines of the reflection grating it passes through the 4-part index, and falls on four photo-electric cells. The index gratings are arranged so that each is displaced relative to the next by a predetermined amount. In consequence, the intensity of the light passing through the various sections of grating varies, and if movement of the machine member takes place, the light transmitted by each grating varies cyclically between maximum and minimum values, the transmissions through the four grating sections being out of phase by equal amounts. Since the pitch of the gratings is 0·010 in., and there are four gratings in the 4-part index, the moving member travels through 0·0025 in. between the transmission of maximum light by one grating and the transmission of maximum light by the next grating in the series.

Light passing through each grating section is monitored by a photo-electric cell, and the magnitude of the resulting current is proportional to the intensity of light transmitted by that grating section. It will be clear that when movement of the machine member takes place, the current varies cyclically, and the currents generated by the four cells are progressively out of phase by ¼-cycle. The current from each cell is applied to modulate one phase of the 4-phase generator—that is, cell No. 1 modulates phase 1, cell No. 2 modulates phase 2, and so on—and the resulting four signals are summed in the reading-head amplifier to form a composite cyclic signal, which is then filtered and squared.

The datum setting control operates in a similar, but simpler, manner. The outputs from the 4-phase generator are connected to four equally-spaced tappings on a 360-deg. potentiometer. Differing proportions of the four phases are selected and combined in accordance with the setting of the wiper of the unit, and from the resulting signal, the required reference phase is again obtained by suitable filtering and squaring.

Reversible transistor counters, with associated number display tubes on the console, are used to count the completed 360-deg. cycles of phase change between the measuring signal and the reference signal, and therefore the net number of grating lines traversed from datum. The residual phase difference is applied to produce a linearly proportional voltage signal for interpolation of the remaining fraction of a grating pitch, which is indicated on the associated meter on the console.

When tape control is used, the required co-ordinate information is transferred from the tape, by way of the tape reader, to decade transistor stores. Direction sensing circuits determine the sign of the difference between the numbers standing on the counter decades and those demanded by the transistor stores, or set on the dial switches when the machine is manually controlled. When the "index" button, at the upper right on the console, is pressed, a rapid traverse a.c. motor drives the feed mechanism of the appropriate machine member in the direction required to change the sign of the number difference. As soon as the point of change is reached, the a.c. motor is disconnected and a slow-approach d.c. servo motor is engaged. At the same time, a 2-decade auxiliary reversible counter is brought into operation to count the number of grating pitches traversed during the overshoot of the machine member, and to control the direction and speed of the servo drive so as to cancel out this overshoot count. Once the cancellation point has been reached, the servo drive is continued at diminishing speed until the interpolated residual error in position is reduced to a negligible value.

As already mentioned, positioning of the machine members takes place sequentially under tape control, and, in consequence, certain of the control circuits can be employed for both axes. A "mirror image" switch is incorporated to enable a punched tape to be used for machining right- and left-hand components of similar design.

USE OF AIR-PROPANE BURNERS FOR RAIL DESTRESSING.—Air-propane burners supplied by The British Oxygen Co., Ltd., Spencer House, Cleveland Row, St. James's, London, S.W.1, are being employed by the Eastern and Southern Regions of British Railways for warming lengths of continuously welded rail before they are fastened down. The object of this treatment is to ensure that the rails will withstand the subsequent stresses of expansion and contraction due to varying weather conditions.

Heating is carried out by means of a trolley which carries four muffles and four propane cylinders, and is moved slowly along a section of track with the muffles directed against the continuously welded rail. Temperature is assessed by measuring the amount of expansion, and it may be noted that when a 500-yard length of rail is raised from just above freezing point to 70 deg. F., it expands by about 4 in.

Some Applications of Radial Diffraction Gratings*

By W. H. P. LESLIE, B.Sc., M.I.E.E.†

The work on which this paper is based was carried out at a period when the National Engineering Laboratory was mainly interested in radial gratings. Applications involving linear gratings, and combinations of linear and radial gratings, now also form part of the programme of research on machine tool control, for which a team is being formed at the Laboratory.

A radial grating, as made at NEL, comprises a thick plate-glass disc, on which is produced, photographically, a uniform pattern of opaque and transparent radial sector lines. Available gratings have from 90 to 32,400 lines and on a typical 21,600-line grating, the lines form an annulus of 11 in. major diameter, and 9 in. minor diameter. The opaque and transparent portions are approximately equal in width and the angular error between any two lines is less than ±3 sec. of arc. Each line represents the average of some 20 superimposed exposures, of 20 different selected lines on a 5-deg. ruled master sector. Errors in the master are reduced by this "averaging" process and it is therefore only necessary to inspect the final copies at, say, 5-deg. intervals.

Such gratings were first applied at N.E.L. to the measurement and subsequent reduction of errors in a gear hobbing machine.[1] The method was based on the assumption that the major source of error was the main worm and worm-wheel drive of the table. A 21,600-line grating was secured to the table and a $21,600/M$-line grating to the worm shaft. Since the worm completed M revolutions for each revolution of the table, signals of equal frequency were obtained from both gratings. The value of M, it may be noted, is normally of the order of 100. These signals were compared in a phase measuring stage, the output of which operated a pen recorder with a full scale reading of 1 min. of arc. The output of the phase measuring stage was later applied to a servo amplifier, electric motor and gear train, which applied angular corrections of the order of 1 deg. to the worm shaft rotation, through a differential gear. In this way errors in the cut gear were reduced to one quarter of the uncorrected value. This method is now being used to apply an overall correction between the hob spindle and table.

A problem arises from the large number of different ratios required between these two rotations, because if a gearwheel of N teeth is to be cut, the hob spindle must make N revolutions for each revolution of the table. It would be expensive, both in time and money, to fit the appropriate radial grating of $21,600/N$ lines for each different gearwheel to be cut. However, a technique already developed for the precision speed control of electric motors up to 350 h.p. enables the same grating of 21,600 lines, on the hob spindle, to be used for all tooth numbers. Special batching counters have been developed, which give one pulse for each N pulses from the hob spindle grating, when the counter is set to N by means of the batch setting controls. These output pulses then occur $21,600/N$ times per rev. of the hob spindle, and can be compared with those from the table grating in the phase measuring circuit.

Several phase measuring circuits have been investigated and applied. For servo control in the error-correction application, only small errors of the order of 5 deg. of phase are allowed to occur, so that a phase detector of limited range can be used. A simple pulse-sampled phase detector has been found very suitable for filtering the signal from this detector, although the circuit is only "linear" over small phase angles. When the phase detector is required to indicate uncorrected error however, some 180 deg. of phase, or more, may be involved. To obtain linearity over this range, a variable mark-space ratio output from a bi-stable stage has been found very useful, and is easy to calibrate.

It is desirable, in production machines, to operate at high table speeds, which involve the error-correcting servo in bandwidths of 20 to 30 c/s. For this type of application, hydrostatic control of the axial position of the worm which drives the worm-wheel appears promising. Moreover, there appears to be no reason for retaining the change gear train between the hob spindle and the worm shaft. Separate electric or hydraulic drives can be envisaged, for the table and the hob spindle, which

* Abstract from a paper entitled "Widening the Applications of Diffraction Gratings for Measurement and Control," presented at the Second International Machine Tool Design and Research Conference, Manchester College of Science and Technology.

† N.E.L., Machinery Group, East Kilbride, Glasgow.

1 See also MACHINERY, 96/785—6/4/60 and 96/1307—8/6/60.

would be accurately and rigidly synchronized, by means of radial gratings, and batching-counter and phase-detector circuits. Setting for various numbers of teeth would then only involve setting the number on the batching counter. The same principle could be applied to screwcutting and feed rates on a lathe. In this instance, pulses from a radial grating on the headstock, and from a linear grating on the slides, could be used to control independent electric or hydraulic drive motors, and would eliminate gearboxes, change gears, and possibly lead-screws.

SINGLE-FLANK CHECKING OF GEARS

A further application of radial gratings which is under active development at N.E.L. is for the single-flank checking of gears. For this purpose, the gearwheel in question is mounted accurately in bearings, in single-flank contact with a similarly-mounted precision master gear, the errors of which are both small and known. When the master gear is employed to rotate the gear under test, non-uniformity in the relative angular motion of the two shafts arises, due to errors in the test gear. These errors can be recorded by fitting the shafts with identical radial gratings, and using batching counters—first to multiply the frequency of the pulse train from the master generator by M, and then to divide this frequency by N, where there are M teeth on the master gear for each N teeth on the gear that is being tested.

The resulting pulse train will then occur at the same rate as that from the test gear grating, so that a phase-detector circuit can be used to indicate tooth error. In such an application, a 21,600-line grating will give a full-scale reading on the phase-detector (for 360 deg. change of phase) corresponding to 1 min. of arc on the gear being checked. Where greater errors may be encountered, one solution is to use a phase-detector capable of operating over wider ranges—for example, up to 3,600 deg. of phase—and phase-detectors of this type have been developed at N.E.L.

Where the ± 3 sec. of arc accuracy of the radial grating is inadequate, there are many possible ways of reducing the error. An obvious one is to make the grating more accurate initially, but there is a practical limit—at present about ± 2 sec.—which is set by the stability of the emulsion and the glass. In addition, there is a practical difficulty. A 21,600-line grating on a 10-in. diameter disc has a line spacing of about 0·0015 in., and an eccentricity of 0·0001 in. can introduce an 8-sec. error at a reading head. By the use of a mean signal from two diametrically opposed reading heads, this eccentricity error can be greatly reduced, provided that the eccentricity does not exceed about one-eighth of a line spacing—or 0·0002 in. There may also be some "wander" of the shaft in the bearing. Provided that the sum of the effects of eccentricity, bearing wander and line spacing does not exceed this 0·0002 in., however, it is possible to construct a system incorporating two radial gratings in which the error of the two gratings should be greatly reduced. For example, one all-round averaging system has been developed by Aitchison, whereby the effects of some 40 per cent of all the lines on a pair of gratings are averaged, to produce a signal which is related to angular position within $\pm \frac{1}{2}$ sec. of arc.

Further progress with this project will depend on finding an independent method of checking the errors. The most promising also entails the use of gratings, but in this instance, an all-round average is obtained by spinning the grating at about 1,000 r.p.m. past a stationary reading head, and a reading head arranged to move with the machine table. A time average of the effect of all the lines on the disc, which affords an accuracy higher than that of the individual lines, is thus obtained. Our aim is to start with the ± 3 sec. of arc gratings, and to obtain agreement with the static averaging method, within an accuracy of 0·1 sec. of arc.

The spinning-disc grating, it may be noted, has also been used with a linear grating, purely as a means of obtaining a dynamic readout from a stationary system. This advantage is also present with radial gratings, and may make the method doubly attractive for dividing-table applications, or for a rotating table or head on a numerically-controlled machine tool. There remains the possibility, for extreme accuracy, of combining both methods of reducing the error.

The author acknowledges that the work described involved many members of the Mechanisms, Metrology and Noise Control Division at the National Engineering Laboratory and is published by permission of the Director of the Laboratory, Dr. Sopwith.

ACKNOWLEDGMENT

This abstract is published by courtesy of Pergamon Press, Ltd., publishers of the *International Journal of Machine Tool Design and Research*, the joint Editors-in-Chief of which are Prof. S. A. Tobias (Birmingham University) and Prof. F. Koenigsberger (Manchester College of Science and Technology). The papers presented at the Conference will subsequently be reproduced in full, in the above-mentioned Journal.

Some Aspects of Die Design for Gravity Casting*

GRAVITY DIE CASTING DIES† are normally made from good quality cast iron, since they can be produced by casting methods with a generally uniform wall thickness of about ¾ in., with the minimum of machining. Chilling by means of thick die sections is avoided, and instead some inexpensive arrangement is employed, which permits of fine adjustment, and also fulfils some other function. The die cavities must be so arranged that the metal will fill the mould in an unbroken stream without turbulence, by careful positioning of the in-gate and the provision of adequate vents. Since most castings require risers, separate vents are not often needed, but if riser apertures are to serve as vents they must be suitably positioned in relation to the in-gate, and the latter should be so arranged that the metal rises gently, rather than falls, in the cavity. With the die layout shown in Fig. 1, there is a long runner leading to the in-gate, to provide a head of metal sufficient to ensure sound castings. Since the greatest pressure is exerted on the lowest part of the casting with this layout, this portion is likely to be the soundest, and the die should be laid out accordingly. An important aim in die layout is to ensure progressive solidification extending from the casting into the risers, and an example of such a layout is shown in Fig. 2. This die is for casting an irregular flat plate of uniform thickness, and it will be seen that the thinnest section has been placed at the lowest position to ensure soundness, solidification extending upwards from this point.

With most dies it is possible to arrange for the material surrounding the risers to be thicker than the remainder. Solidification is then delayed in the risers, and they can be of reduced proportions. Die sections surrounding the runner can also be increased, and in extra metal thus provided, a "shrink pad" can be machined as shown in Fig 2. This shrink pad is, in effect, a blind riser, and it feeds the casting adjacent to the in-gate, which takes the last of the metal to leave the runner.

* Abstracted from papers presented at a Die Design Symposium held by the Light Metal Founders' Association, in Birmingham on October 3, 1961.

† Basic Principles of Die Design. By W. Goode, Birmingham Aluminium Casting (1903) Co., Ltd.

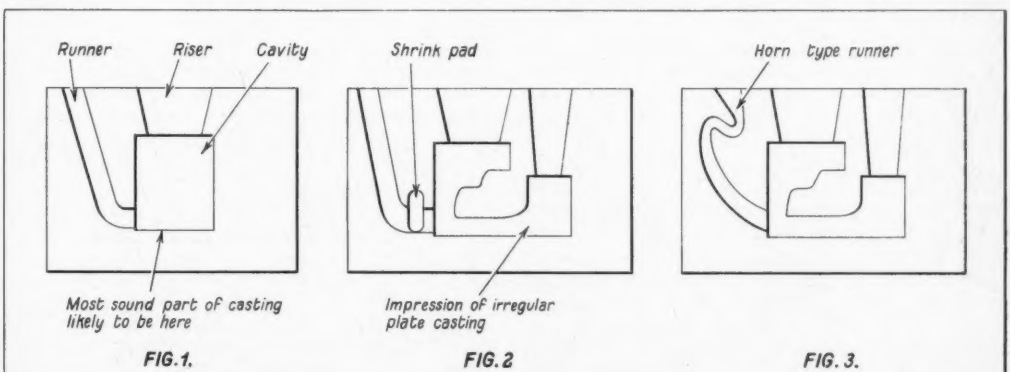


Fig. 1. A head of metal sufficient to ensure a sound casting is provided by this die layout. Fig. 2. An increase in the amount of molten metal available near the in-gate may be obtained by the use of a shrink pad, or blind riser. Fig. 3. Turbulence in the casting cavity, resulting from excessive speed of the molten metal, may be avoided by the use of a "horn runner"

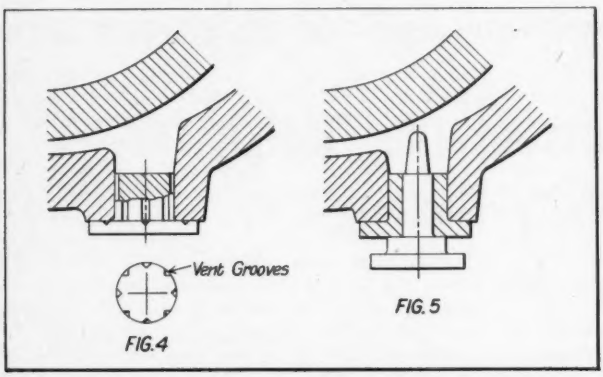


Fig. 4. Pockets in a die, in which bosses or other heavy-section projections are formed, may be vented by means of grooved plugs. Fig. 5. A plug may be used for chilling purposes, or for coring a hole in a boss or other casting projection. By reducing the diameter of the projecting end, damage to the coating, or sticking of the plug in the bush, is avoided

Although it may be possible to machine the runner to a greater depth after making a trial cast, so that it may also act as a feeder, there is a danger that greater skill in pouring may be required subsequently, to avoid turbulence. The need for a check on the pouring speed to avoid turbulence is met by placing the runner at an angle, as in Fig. 1 and 2, but better control can be obtained by the provision of a "horn runner," of the type seen in Fig. 3. This design of runner changes the direction of flow temporarily, and very satisfactory results may thus be obtained. Controlled tilting of the die, as filling proceeds, is even more effective than the horn runner, but may be costly as regards man-power or mechanical equipment, and this extra cost may not be justified except for heavy castings of long, thin, shapes, which are required in large quantities.

With complex dies, the performance of which is difficult to predict, it may be necessary to pour metal into the risers, and possibly to lag or externally heat the risers to ensure that the metal that they contain is last to freeze. Uniform die temperature can sometimes be ensured by duplicating the runner channel on the opposite side of the cavity, so that the channels serve alternately as runners and vents. Most of the heavy sections required on castings take the form of bosses which can be readily chilled to ensure that adjacent thin sections do not draw metal away, and leave them incompletely filled. Such heavy local sections, however, often necessitate pockets in the die, which must be vented to avoid trapping air.

A vent normally takes the form of a grooved plug, as shown in Fig. 4, and plugs of this type can be used effectively as chills. The insulating, protective coating applied to the internal die surfaces is omitted from the plug, so that direct contact chills the molten metal. Varying degrees of chilling can be obtained by the use of copper plugs, plugs with fins which may be subjected to an air blast, plugs arranged for controlled water-cooling, or plugs which may be removed at a predetermined stage in the casting cycle and cooled in water. An example of this last-mentioned type, which is usually employed also for coring, is shown in Fig. 5.

Normally, the type of plug shown in Fig. 5 is made in two parts, and only the centre pin is extracted. If it were made as a solid piece and subjected to the sudden heat stresses involved in die casting, early failure would be likely to occur at points of abrupt change of section. Another advantage of the two-part arrangement is that the bush portion provides an effective reaction surface against the sharp jolt required to separate the core projection from the grip exerted by the contracting casting, in spite of the taper provided on the core.

The amount of taper provided on the core may be varied within limits to suit the customer's requirements, but reductions in taper usually result in increased costs. A core of the type shown in Fig. 5 should always have a step between the portion which is surrounded by molten metal and the shank. Growth of the end portion which is in contact with the casting, caused by successive heating and cooling, will not then cause the shank of the core to jam in the bush portion. Such an arrangement also ensures that a coating applied to the projecting portion of the core is not damaged by withdrawal.

CORE AND DIE COATING CONSIDERATIONS

It is also necessary to ensure that protective coatings applied to cores are preserved intact after they have been removed from the dies. The best method of protecting such coatings is to suspend the cores, by hooks attached for the purpose, on a rig in some convenient place away from the immediate working areas until they are required for re-insertion in the dies. When a coating is applied to the entire surface of an impression, care must also be taken to ensure that damage is

not caused on opening the die. In certain instances, it may be necessary to provide a step in the joint to guard against such damage. In addition, care must also be taken to avoid application of the coating to joint faces, which are not always readily identifiable.

Since runner channels and risers pass through the joint, the application of protective material may be inadvertently extended over the adjacent joint faces, as seen in Fig. 6. The fact that increased thicknesses of protective materials are usually applied to runner and riser channels, to extend the period of fluidity until the casting has solidified, increases the difficulties. When such a die is closed and the stirrup-type clamps shown in Fig. 6 are moved over the cam forms on the opposite die half, to secure the two halves together, the die will be prevented from closing properly if there is coating material on the joint faces, and damage may be caused.

This difficulty can be avoided by moving the joint line to the position shown in Fig. 7, so that part of the cavity and the runner and riser channels are cut in both faces. In this simple example, no alteration of the casting form is required, but many die modifications necessitate some changes in the castings. Where such modifications are unacceptable to the customer, a casting may be made with the protective coating applied to the joint face. This casting is then laid in the impression to protect the coating while the material is removed with a wire brush.

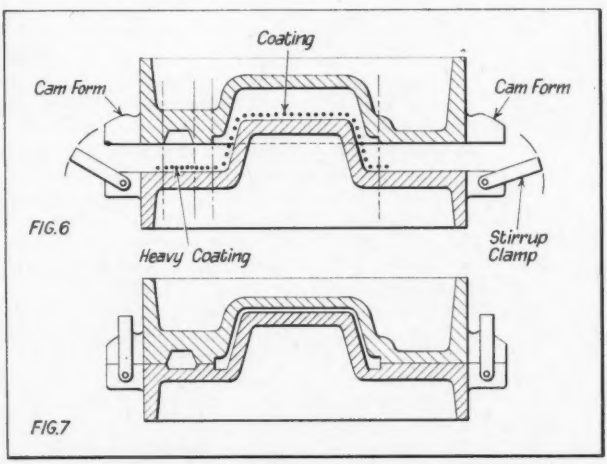


Fig. 6. Die coating inadvertently applied to the joint faces may result in damage to the die, when the stirrup type clamps are applied. Fig. 7. Clear indication of the positions of the cavity and runner channels in the die faces, to which coating is to be applied, is afforded when part of the cavity is cut in each member

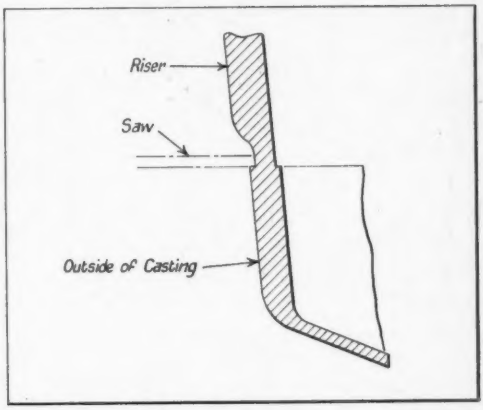


Fig. 8. A step in the riser indicates where the saw cut should be made

REMOVAL OF RUNNERS AND RISERS

Where a band saw is employed for the removal of runners and risers from castings, the parts to be severed must be of such a form that the saw blade will not be caused to wander or kick, with consequent risk of injury to the operator or damage to the casting. A suitable design is shown in Fig. 8, where it will be seen that a definite step is provided between the casting and the riser. The internal step shown is not essential to indicate the edge of the casting, but is a coating relief intended to reduce die-operating costs.

With a complex joint line, the designer may be tempted to carry the cavity form straight into the riser or runner channel without a step, for the sake of simplicity or to facilitate machining, but this course must be avoided. Since the riser cavities must be maintained at a higher temperature than that of the casting, moreover, to avoid the transfer of warpage, it is preferable to split the die at the step between the casting and the riser. In general, machining of the main cavity may be simplified by splitting the die into a number of

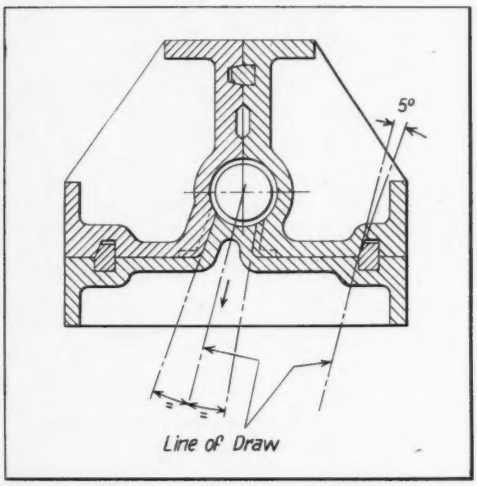


Fig. 9. Location of the various parts of a die in relation to each other may best be ensured by providing keys of approximately rectangular section, which project to a greater height than either of the sectional dimensions

pieces, which are subsequently dowelled and bolted together, and this arrangement has the added advantage of providing for excellent venting. On the other hand, rapid production of the die and subsequent maintenance operations are facilitated by keeping the number of separate pieces in a die assembly to a minimum.

DIE LOCATION AND CAVITY LAYOUT

Because both parts of a gravity die rest on the work-table, location is normally required only in a horizontal direction, and the most satisfactory arrangement so far devised is shown in Fig. 9. In the 3-part die here shown, location is taken from keys of approximately rectangular section, which project to a considerably greater height than the sectional dimensions. Sufficient lead must be provided on the flanks of the keys for easy engagement, and consideration must be given to the line of draw of the particular part of the die. This line of draw may be predetermined by the shape of the casting or the layout of the die.

Many advantages over the plain 2-part die, which is separated into two pieces when it is opened, are afforded by the book-type die. Such a die is arranged with the members pivoted on a pillar on the base, so that it can be opened and closed like a book, only one clamp being required to hold it shut. With many castings, only slight modifications to the shapes are required to permit the use of book-type dies, which give more rapid production due to reductions in the times required for applying and releasing the clamps. With such a die, since the parts are always in a fixed relationship and a set position on the base, a more definite rhythm of manipulation can be attained.

Many castings are made in dies of the type shown in Fig. 9, in which a tubular component with attachment brackets is produced. It is probable that the designer of the casting required a tube to which brackets were to be welded. Subsequently, it was decided that the numbers involved warranted the cost of a casting, and a drawing of the same part was sent out to a foundry without consideration of the problems involved. If the drawing had been considered from the standpoint of the casting method to be used, undercuts, necessitating a 3-part die, could probably have been eliminated to enable a 2-part die to be used.

Instances of this type are often encountered in the die design office, and efforts to secure modification are initiated by the supplier. If customers buying castings would adopt a policy of consultation with the die design staff of the foundry, the designers would be relieved of a considerable handicap, and much correspondence would be avoided. In addition to a component drawing, the die designer should be supplied with information concerning the position the part is to occupy in relation to other parts of the assembly, also of its function. Generally speaking, where a component formerly made by fabrication or sand casting is to be gravity die cast, features which serve no function may be omitted or modified, and others, such as strengthening ribs, may be added.

Ribs intersecting at an acute angle are to be avoided because of the resulting weakness in the

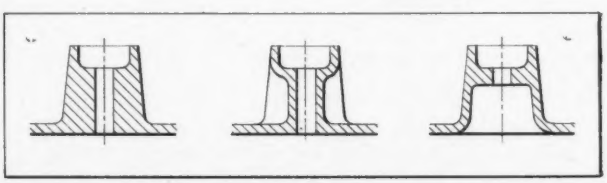


Fig. 10. Alternative methods of reducing a heavy section (left) are here shown. The method chosen usually depends on which die member can be most easily machined

die, usually accompanied by a local hot spot which is difficult to cool. Local heavy sections can often be reduced by the use of ribs or pockets in the casting, the method selected depending upon which die member may be more easily machined, or upon considerations of die operation. Two alternative methods of reducing a heavy section are illustrated in Fig. 10, the original design being seen at the left. Some examples of arrangements which may be adopted to avoid undercuts are shown in Fig. 11, the preferred designs being seen at the right. The view at the bottom right shows a design which permits the production of a window opening without the need for a moving core, the wall being disposed at an angle. Projections on the faces of the opposing die halves mate to produce the required opening.

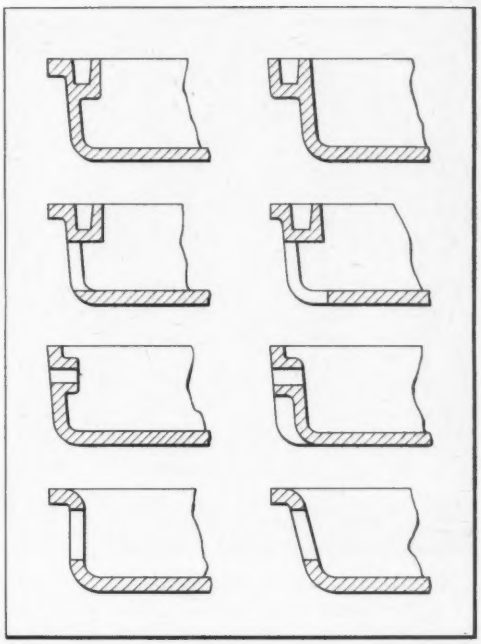


Fig. 11. Some examples of designs which may be employed to avoid undercuts on a casting. A window in a casting wall may be produced, as at the bottom right, without the use of cores

CASTING COST CONTROL IN GRAVITY DIE DESIGN*

Although the demand for pressure die castings greatly exceeds that for gravity die castings in the U.S.A., there is still a large potential market for gravity die castings in this country. *Pressure die casting is becoming highly automated, and the casting costs reflect the low degree of operator skill required, and the rapidity of production achieved. Unfortunately, gravity die casting is still an art surrounded by jealously-guarded "know-how," and much can be learned from those concerned with the pressure process for which die temperature, filling and cooling time, and metal pressure are closely controlled.

Gravity dies must frequently be designed to produce castings with undercuts, sectional changes, close tolerances, and good surface finish, at an economical price. Although the time required for the operation, and the number of casters and assistants required, usually account for the greater part of the overheads associated with a casting, many foundries have been slow to take advantage of available means for increasing the rate of output. This statement does not apply to the production of pistons by gravity die casting, for which semi-automatic machines fitted with 2-impression dies are widely employed. With such facilities, one operator, tending more than one machine, can produce up to 360 piston castings per hour.

Designers of dies employed for this purpose have been quick to adopt equipment available from specialist suppliers in the fields of hydraulics, pneumatics and electronics. As a result, gravity dies employed for the production of pistons are often equipped with solenoid-controlled, hydraulically-actuated members, the movements of which are electrically interlocked, and electronic timers are provided to control the solidification periods. It is disappointing to record that similar methods are not usually adopted for the production of other gravity die castings, even if they are required in larger quantities than are pistons.

Probably the simplest method reducing the operation cycle time for a die is by providing power assistance with the aid of a pneumatic cylinder. An example of such an arrangement is seen in Fig. 12, applied to a small gravity die for producing an impeller casting with 12 blades on one side. These blades are produced in the spaces between a corresponding number of radially-moving cores in the die, and the cores would normally be levered into and out of position manually. In the die illustrated, each of the cores is connected by a pin to a slotted cam-plate beneath, as shown diagrammatically in Fig. 13. The pins engage curved holes in the cam-plate, and they also pass through slots, radial to the die centre, in a plate in which the cores slide.

The cam-plate is connected, by a bracket at one

* Casting Cost Control in Gravity Die Design for Aluminium Alloys. By R. R. Westwood, High Duty Alloys, Ltd.

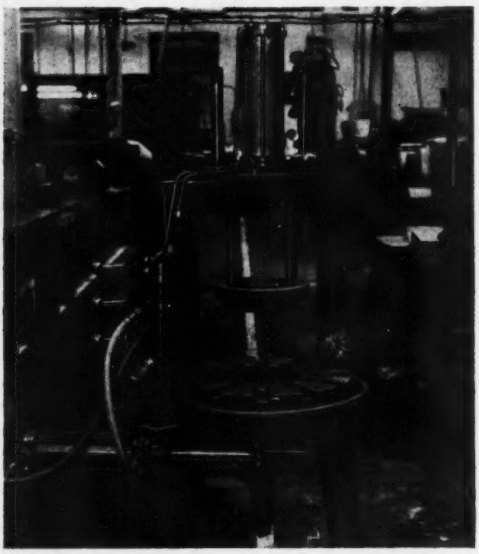


Fig. 12. One of the simplest methods of speeding up die operation is by the use of air cylinders, three of which, in this example, are provided for power movement of cores, a die member, and an ejector

side, to the ram of a pneumatic cylinder secured to the framework which supports the die, so that when the cylinder is operated the plate is turned. This action causes the pins to traverse the slots, and the cores are moved towards or away from the die centre. A superstructure above the die supports another air cylinder, and the ram of this cylinder carries the upper die member, which has an annular projection. When this die member is lowered, the projection engages steps on the advanced cores, to lock them in position for casting. A third air cylinder is connected to an ejector in the base of the die, which facilitates removal of the casting. No provision is made for interlocking the movements, the three air cylinders being controlled by separate valves at the left in Fig. 12. Such provision could easily be made, however, by incorporating pilot valves or limit switches which would be actuated by die members on reaching the ends of their respective strokes, and would control the subsequent stages in the cycle.

HYDRAULIC OPERATION OF GRAVITY DIES

An intermediate step towards hydraulic operation of die members is the use of hydro-pneumatic equipment whereby compressed air is employed as a source of power. Hydraulically-powered movements can be controlled more accurately, and the jerky action which may result when air cylinders are employed for moving heavy members is avoided. A very simple arrangement of air-powered hydraulic equipment from the range made by Maxam Power, Ltd., is employed on one large die in the gravity foundry of High Duty Alloys, Ltd., Slough. For this die, each side of the hydraulic actuating cylinder is supplied from a small air/oil cylinder mounted above.

One of the greatest advances in the mechanization of the gravity die casting process has been made possible by the availability of self-contained hydraulic pump units which are used in conjunction with non-inflammable fluids. Such a unit is shown in use in Fig. 14, where it is installed on the floor alongside a power-operated die unit to which oil is delivered at pressures up to 1,000 lb.

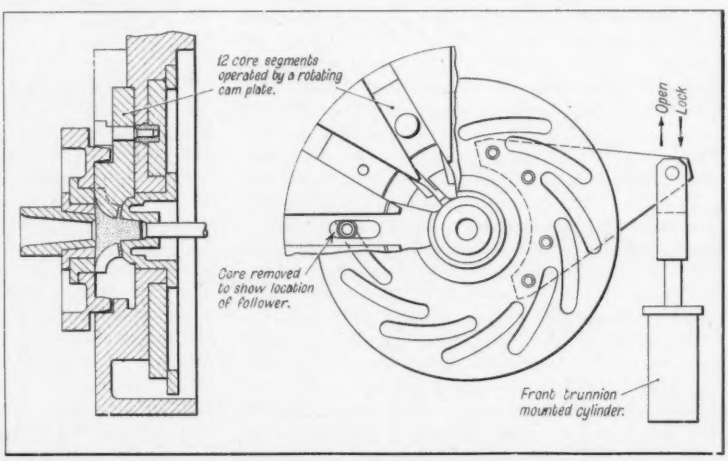

12 core segments operated by a rotating cam plate.
Open
Lock
Core removed to show location of follower.
Front trunnion mounted cylinder.

Fig. 13. Views showing the method of operating the cores in the die in Fig. 12, which is designed for the production of a 12-bladed impeller casting. The cores are moved by pins which pass through slots in a cam plate

per sq. in. Hydraulic cylinders are employed to move the various die members, and for long core movements, hydraulically-operated toggle mechanisms are provided which avoid the need for the application of levers to unlock cores. Small cylinders are employed for the application of the die clamps.

The complete sequence of movements of the various die parts is controlled by push-buttons at a central station, and the movements are electrically interlocked to prevent accidents. With such a die-operating unit, the operator has only to pour the casting and press a pedal- or push-button-switch, to start a timer whereby the solidification period is controlled. The die is then automatically opened in the pre-set sequence, and the casting is ejected so that it can be lifted out with tongs. For the largest of the die units employed in the High Duty Alloys foundry, an automatic ladle is employed, and the smaller units are operated in conjunction with automatic tilting equipment, as will be described later.

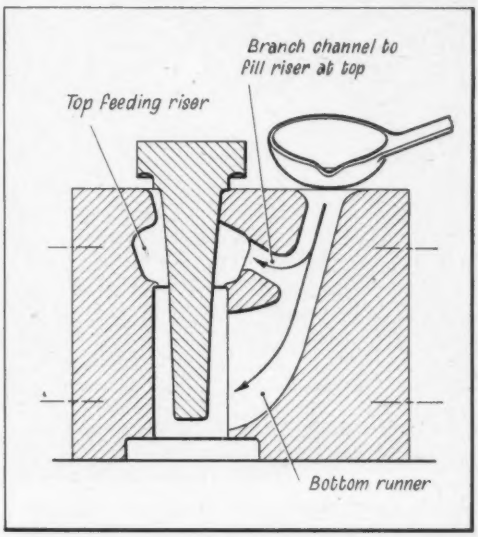


Fig. 15. Undesirable temperature gradients in a die may be avoided, or reduced, by the provision of a branch channel which connects the bottom runner with the top riser

DIE COST AND LIFE CONSIDERATIONS

When designing a die, the extent of the refinements provided will depend largely on the number of castings to be produced. A simple hand-operated die costing £300 may be adequate for the production of 5,000 castings per year for two years, and many desirable features for reducing casting production costs which could be incorporated may have to be omitted because the extra cost could not be recovered. On the other hand, a demand for 500,000 castings per year for three years would justify a fully mechanized die, which might cost £3,000. The designer is usually guided by the price at which the casting must be produced, and the permissible expenditure on the die, and can thus determine the degrees of elaboration and mechanization that are justified.

Fig. 14. Power-operation is extensively employed in the gravity foundry of High Duty Alloys, Ltd., Slough, for both small and large dies. Non-inflammable fluid is supplied under pressure by hydraulic pump units

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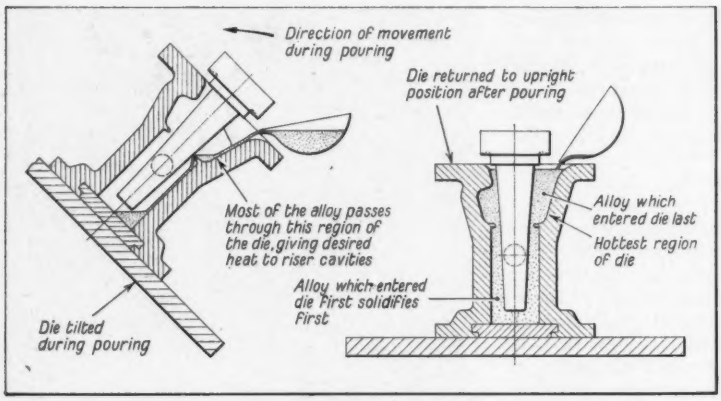

Direction of movement during pouring
Die returned to upright position after pouring
Most of the alloy passes through this region of the die, giving desired heat to riser cavities
Alloy which entered die last
Hottest region of die
Alloy which entered die first solidifies first
Die tilted during pouring

Fig. 16. Rapid filling of the die cavity through the top riser may be achieved without turbulence by tilting the die at an angle, which is gradually reduced as the metal level rises

Factors which affect the soundness, definition, surface finish and accuracy of the casting include the disposition of the cavity in the die, and the way in which the alloy is allowed to fill and solidify in the cavity, also the method of removing the casting. If good quality castings are to be obtained, the arrangement of the runner channels and risers must be such that turbulence of the metal in the cavity is avoided, and adequate venting must be provided. Although the weight of saleable castings obtained in relation to the total weight of alloy poured is extremely important, side or base runners, in conjunction with top feeding risers, are still commonly used in Britain.

RUNNERLESS SYSTEMS OF POURING

The ideal method of ensuring favourable temperature gradients in the die and casting is to dispense entirely with bottom or side runners wherever possible, and to pour directly into the top risers. All the metal which enters the die thus passes through the top, and the resultant temperature gradients help to ensure that solidification progresses upwards from the bottom of the casting, and is finally completed in the top risers. The difficulty with this method is that turbulence is set up when the molten metal is poured into the riser and allowed to fall to the bottom of the die, but this trouble can be overcome by tilting of the die, as shown in Fig. 16.

Dies of any weight can be tilted under power, and it is only necessary to provide trunnion bearings, an air or hydraulic cylinder and a pedal-operated valve, all of which may be purchased for about £20, and a typical die in the tilted position is shown in Fig. 17. This modest addition to the cost of a die is rapidly recovered by the savings that result from the elimination of bottom running. The finned air-cooled cylinder head shown in Fig. 18 is an example of a casting successfully produced by means of the riser-pouring method.

The sizes of runners and risers, and their positions in relation to the cavity, depend on the design of the casting and the positions of the parting planes in the die. For a given size, a riser will feed more efficiently if the movement of the fluid metal is assisted by gravity. In certain instances, feeders may have to be positioned below the portions of the casting which they are to feed, and side shrink pads are often employed, especially in the casting of pistons. With such arrangements, the hydrostatic head created by the molten metal in the casting impression and in the top risers, tends to oppose the movement of metal from the side risers, and reliance must be placed mainly on atmospheric pressure. In the circumstances described, at least one riser surface should be exposed to atmosphere, and blind risers should be avoided if possible.

In general, the larger the mass of the metal solidifying in the die, in relation to the combined surface areas of casting and risers, the longer will be the solidification time and the slower the production rate, if heat is dissipated from the die by natural cooling only. It is obvious, moreover, that production rates can be increased if the ratio of metal in the runners and risers to that in the casting cavity can be kept low.

An increase in the yield from a gravity die may be obtained by arranging that the larger masses of iron or steel are in positions in which they will act as heat reservoirs to delay solidification of the risers, and by reducing the die wall thickness in positions adjacent to the cavity so that the casting cools at a slower rate. Risers of smaller dimensions may then be provided, with corresponding reductions in the amount of metal to be re-melted per casting. Specially-designed gas burners may also be applied

to certain areas of the die surface, and provide a much more economical and controllable means of increasing riser efficiency than the use of larger risers. On the other hand, solidification of the casting may be accelerated, if required, by air or water cooling arrangements.

A method of reducing fettling costs, which is being adopted increasingly in the U.S.A., is to design the gates in such a way that the caster can break off runners and risers after removing the casting from the die. Gates of notched form are employed for this purpose, but the resulting advantages must not be gained at the expense of feeding efficiency. A good guide to the size of the gate leading from the runner is afforded by the thickness of the adjacent casting wall. Where a full stream of metal is required to spread out from each side of the gate, the width of the latter should be about twice the wall thickness, otherwise, the width should be approximately the same as the thickness of the wall in the adjacent area.

If possible, gates should be confined to one face of a casting to enable the runners and risers to be removed with a circular saw. This method is being increasingly employed, and gives much more accurate results than band-sawing. External fettling beads, on which gates for runners and risers can be positioned, can usually be included in casting designs, by negotiation with the customer, and gating on to curved or other shaped surfaces avoided. Ideally, flat surfaces which are to be subsequently machined should be used for gating, provided that jig or fixture locations are not obstructed. If it can be ensured that the machining allowance on such surfaces are not seriously increased, witnesses left by the removal of runners or risers can be removed during the operations without difficulty, and the need for further fettling is thus avoided.

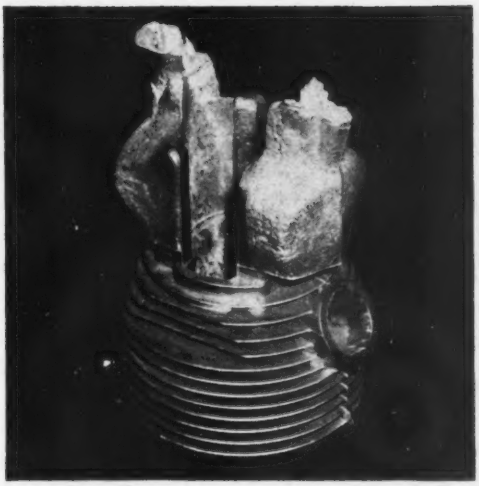


Fig. 18. This finned cylinder head for an air-cooled engine is an example of an intricate casting produced by the tilting technique

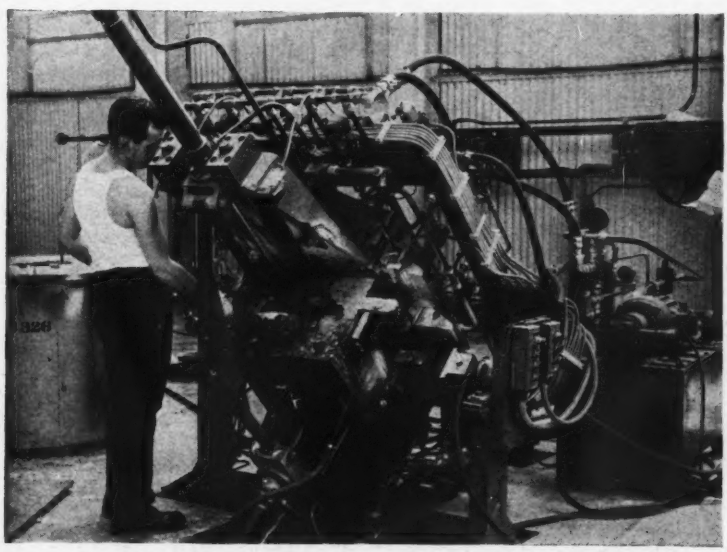


Fig. 17. An example of a small hydraulically-operated gravity die arranged for tilting to permit of pouring through the top riser. The whole assembly is mounted in trunnions, and the tilting movement is obtained by means of a cylinder

The author expressed his thanks to the directors and management of High Duty Alloys, Ltd., for their permission to use the major part of the material included in the paper, and for their help and co-operation in its preparation.

M2

Factory Equipment Exhibition

THE INTERNATIONAL FACTORY EQUIPMENT EXHIBITION, which was held recently at Earls Court, London, occupied a floor area of some 375,000 sq. ft., and more than 350 firms took part. As on previous occasions, a wide range of products was displayed, and attention is here drawn to some of the items likely to be of particular interest to readers of MACHINERY.

Built by Malicet et Blin, Aubervilliers, Seine, France, the type BA Brinell hardness tester shown in Fig. 1 was exhibited by the sole distributors in this country, Engineering & Scientific Equipment, Ltd., 287-289 Old Street, London, E.C.1. Designed for operation on a fully-automatic cycle, this equipment may be employed for testing forgings and castings on which no machining for surface preparation has been carried out, and Brinell readings are obtained on a dial-type indicator from the depth of penetration of the ball indenter.

Workpieces to be checked are loaded into a vertical magazine chute by hand, or alternatively, from a vibratory hopper feed unit, and are delivered, one at a time, from the lower end into openings in a circular indexing table, where they are supported by a lower, non-indexing table. At each working cycle, the upper table is indexed to bring a workpiece between the anvil and the indenter. The anvil is now raised hydraulically to bring the workpiece into contact with the indenter, and a pre-load is then applied. Next, the dial indicator is automatically adjusted for zero, and the pre-set load for hardness testing is applied to the work for a predetermined period, which can be varied from 3 to 30 sec. One of three coloured signal lamps on the indicator head is then lit, depending upon whether the component is of the required hardness, too hard, or too soft. If the hardness is above or below the required value, one of two swivel gates, built into a chute which extends from the anvil, is swivelled electrically towards the centre. Next, the anvil is lowered to its original position, and the table is then indexed, whereupon the component is discharged down the inclined chute, and another part is brought to the testing position. Workpieces which are within the specified tolerance for hardness pass down the chute to be discharged into a central container, and those which are too hard or too soft are deflected by the gates into other containers at the right and left. A counter is provided which gives a continuous indication of the number of parts checked which are of the required hardness. As an indication of the productive capacity of the machine, it is stated that brake cylinders for cars can be tested at the rate of 600 per hour. Tungsten carbide ball indenters of 5 and 10 mm. diameter are provided, and loads of 500, 750 and 3,000 kg. can be applied.

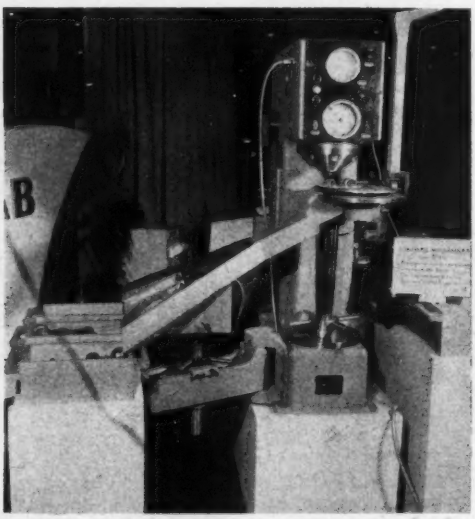


Fig. 1. Malicet et Blin type BA fully-automatic Brinell hardness tester

PRESS TOOL FOR PROTOTYPE WORK

The new Uni-Centre press tool which has recently been placed on the market by Redman Tools & Products, Ltd., Gregory's Bank, Worcester, was shown set up for demonstration on a fly press, as illustrated in Fig. 2. This tool which is primarily intended for use on a power press, is so designed that the punch, die and stripper can be readily changed for others of different sizes, to enable holes of various diameters up to 3 in. to be quickly pierced in prototype sheet metal parts. After a clamping screw at the right-hand end of the bolster has been released, the die can be raised by means of a ball-ended lever at the front, and then removed from the bore by hand. The punch is held by a socket-head grubscrew in the bore of a sleeve in the upper part of the tool, and the flanged, ring-shaped, stripper plate is retained in

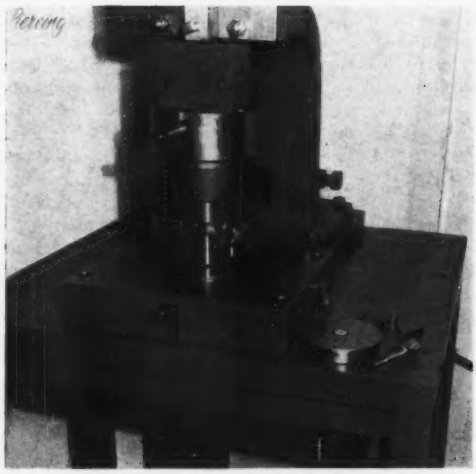


Fig. 2. This Uni-Centre press tool, which was exhibited by Redman Tools & Products, Ltd., enables holes of different diameters to be readily pierced in prototype sheet metal components

the spring-loaded holder by a swing plate. When a threaded clamping knob has been released, this plate can be swung clear, to enable the stripper to be removed from the holder.

After a punch, die, and stripper plate of the required sizes have been assembled, the sleeve in the upper part of the tool is lowered by movement of another ball-ended lever, with the result that the punch is held lightly in contact with the work material by spring action. The work material is then adjusted on the die until a circle, which has been marked on the top surface at the position where a hole is to be pierced, coincides with the periphery of the punch. During the first part of the downward movement of the ram, at the beginning of the working cycle of the press, the sleeve which carries the punch is pushed upwards in the upper part of the tool, and is automatically held at the top of its travel. Continued downward movement of the ram then causes the punch to be passed through the work material for the piercing operation to produce the required hole.

PROGRAMME-CONTROLLED MILLING MACHINE

On the stand of Crouzet England, Ltd., 1026-1028 Harrow Road, London, N.W.10, was shown the type 133 horizontal milling machine, built by an associated company in France, which is arranged for operation on a fully-automatic, programme-controlled cycle. The machine was fitted with a 10-in. diameter, air-operated indexing table as illustrated in Fig. 3, to which movement is imparted automatically during the working cycle. Movements of the table, cross-slide, and knee on this machine are effected by air cylinders to which the supply is admitted by way of electrically-operated valves attached to the end covers. Associated with each air cylinder there are two hydraulic cylinders, incorporating valves with micrometer adjustment, and with this arrangement, feed can be varied independently for each direction of travel, up to a maximum of 39·4 in. per min.

Traverse movements longitudinally, transversely, and vertically are controlled by adjustable stops, and different programmes can be set up with the aid of plugs which are inserted in sockets in a panel on the inclined top face of the control panel seen mounted on the floor at the left-hand side of the machine. A variety of operating cycles can be quickly obtained with the aid of transparent plastics charts which indicate movements of the table, cross-slide and knee in different combinations, and have holes at various points. For setting up, one of these charts is placed on top of the control unit, and plugs are passed

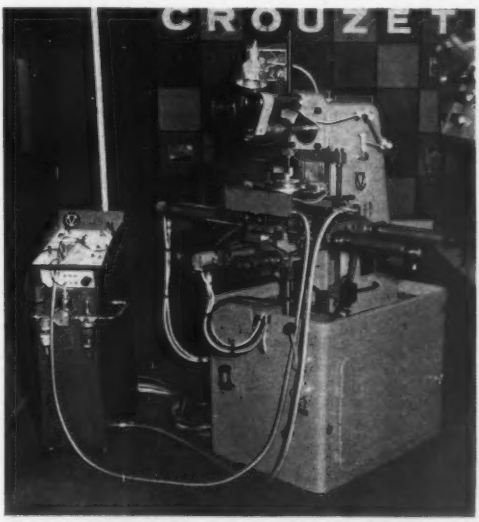


Fig. 3. Longitudinal, cross, and vertical movements on this Crouzet programme-controlled milling machine, are imparted by air cylinders, and feeds are controlled by separate hydraulic cylinders

through the holes into the sockets. At the end of a traverse movement, one of the plugs causes a micro-switch built into the control unit to complete a circuit, and the resulting signal is fed to the valve on one of the air cylinders to initiate the next movement in the cycle.

The 20- by 6-in. table has a maximum traverse of 8 in., and the cross-slide a movement of 3·15 in. A travel of 13 in. is provided for the knee, and the maximum distance obtainable between the cutter spindle and the top surface of the table is 15 in. Twelve spindle speeds ranging from 80 to 3,500 r.p.m. are available.

Another exhibit was a Crouzet 5-in. centre lathe which was fitted with an arrangement of air and hydraulic cylinders similar to that employed on the milling machine, for traversing the saddle, also for operating a pusher attachment on the bed whereby deep-drawn cup-shaped components were transferred from an inclined conveyor to the collet in the headstock spindle, for automatic loading. During the working cycle, the cross-slide was advanced towards the work axis, and the saddle was then traversed to the left, for turning an internal chamfer on the component. A separate air cylinder was fitted for closing and opening the collet at the beginning and end of the cycle.

AIR-HYDRAULIC PUMP

In Fig. 4 is shown the type P-707 air-hydraulic pump which has recently been added to the Porto-Power range of hydraulic equipment marketed by Blackhawk, Ltd., 12-16 Brunel Road, Acton, London, W.3. Weighing only 8¼ lb., this unit is designed for operation by compressed air, at a maximum pressure of 180 lb. per sq. in., and incorporates a diaphragm-type pump, which delivers hydraulic fluid at increased pressure in the ratio of 95 to 1. When the pump is operated in conjunction with a pipe bending machine, for example, as was demonstrated at the exhibition, a maximum force of 10 tons may be applied to the forming head. A pivoted control arm, which embraces the body, can be operated by hand, foot, elbow or knee, for instance, and when it is depressed in one direction, compressed air is delivered to the pump, and the pressure that is built up in the hydraulic system is indicated to some extent by the noise level of the air discharge from the unit. Movement of the control arm in the other direction results in release of pressure in the hydraulic system.

The pump is designed to ensure that pressure in the hydraulic system is maintained in the event of failure of the air supply.

Fig. 4. The new Blackhawk Porto-Power type P-707 air-hydraulic pump

ULTRASONIC SENSING AND SWITCHING EQUIPMENT

Westool, Ltd., St. Helens Auckland, Co. Durham, exhibited their new Sonac ultrasonic sensing and switching equipment, which may be employed for a wide range of duties including counting and level control. The equipment comprises a control unit incorporating a transistorized amplifier and a plug-in output relay, and two matched sensing heads. In operation, electric signals from the control unit are converted into ultrasonic signals by one of the sensing heads. These signals are continuously transmitted by the head, to be received by the second head. Ultrasonic signals are converted into electrical signals by the second head, which are then applied to the control unit, and in this way a closed loop is formed. Any interruption in the reception of acoustic signals causes the output relay to be de-energized, with the result that a switch or a visual or audible warning system may be operated.

PROJECTOR MICROSCOPE

The Swiss-built Projectina projector microscope illustrated in Fig. 5, which was exhibited by R. G. MacFarlane, 8 Montgomerie Terrace, Skelmore, Ayrshire, may be employed for examining metallurgical specimens, also for inspecting a wide variety of precision workpieces, and enables magnifications up to 3,000× to be obtained. If required, the image of the piece to be examined can be projected from the rear of the instrument on to a screen with dimensions up to 2 ft. by 7 ft., which may be mounted on a wall. With another arrangement, the image can be observed through a binocular eye-

Fig. 5. Magnifications as high as 3,000× can be obtained with this Projectina projector microscope

piece attachment which is intended to be mounted on the inclined front surface of the instrument.

The microscope can be supplied fitted with two magnifying lens units and work-tables with micrometer adjustment, also lamp units for illuminating the surface of the work. With this arrangement, the images of two components may be projected simultaneously on to the circular screen, to enable them to be compared. A film holder and focusing screen attachment can be fitted, and the magnified image of the work can then be recorded photographically.

Human Relations in Industry

Mr. Harold Burke, president of The Institution of Production Engineers, has stated that his recent suggestion concerning the appointment of a Minister of Production should in no way be regarded as advocacy of a policy of nationalization. He is, however, deeply concerned with the problem of human relations.

"The industrial disputes that have been going on in this country almost since the end of the war are not to the credit of any of the participants. We must recognise that these disputes are most damaging to us as an industrial nation and no useful purpose is served by claiming that other countries may be worse than we are in this respect. I suggest, therefore, that the present machinery for dealing with industrial disputes needs fresh thinking.

"It seems clear that the present arrangements between employers' federations and trades unions, with an intermediary from the Ministry of Labour, are not proving entirely satisfactory. I believe that, in a modern democracy, it should be possible for employers and trade unions to discuss all their problems with a reasonable chance of reaching some agreement without stopping work, and I appreciate that this is always the object behind such discussions. There are, however, all too many occasions when this does not work out, with resultant hardship to the industries and to the workpeople and their families, and often with a bitterness that takes time to eliminate. In such circumstances, I feel that a panel of industrial advisers could make a major contribution in recommending terms of settlement in the interests of the national economy and of the industries.

"On several occasions the bar to settlement has been stubbornness on the part of certain individuals. I recognise that neither industrialists nor trades unionists would be willing to accept Government direction in the conduct of their affairs, but I suggest that this is mainly due to the fact that the average man in industry regards members of the Government as politicians or civil servants who do not understand the day-to-day problems of industry. This is probably true in the majority of cases. We have to recognize that we do have industrialists in prominent positions in the Government, but I still maintain that an independent industrialist at a very high level is needed to guide future thinking on industrial relations."

Trade Publications

KABI (ELECTRICAL & PLASTICS), LTD., Kabi Works, Cranborne Road, Potters Bar, Middlesex. Catalogue supplement giving particulars of newly-introduced bins, tanks and containers, beakers, and stacking boxes.

EMI ELECTRONICS, LTD., Hayes, Middlesex. Well-illustrated brochure concerned with the Emicon B 100 machine tool position control system which gives a positional accuracy of $\pm 0{\cdot}002$ in. Sections are devoted to measurement, programming, and the use of tape control, and a complete technical specification is included.

STEDALL & CO., LTD., 192-204 Pentonville Road, Kings Cross, London, N.1. Folder giving particulars of various Rust-Oleum products including 769 damp-proof red primer which can be applied directly over rusted metal, also Galvinoleum coatings for application to galvanized metal surfaces. A colour chart of finish coatings is provided.

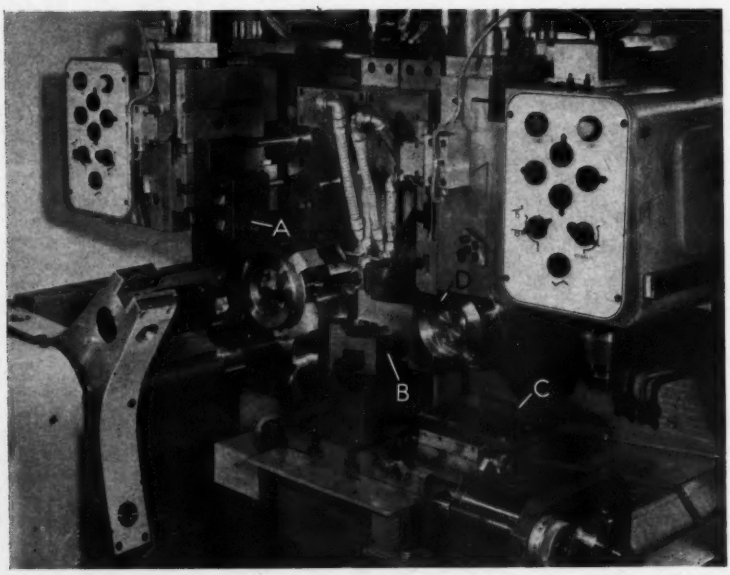
Pittler Pidofat Demonstration

B.P.S. Machinery & Spares Co., Ltd., 245 Knightsbridge, London, S.W.7, recently staged a demonstration in Birmingham of the Pittler Pidofat front-loading, 2-spindle, chucking automatic, for which they are the sole agents in this country. Two short films, with commentaries, concerned with various production set-ups on Pittler machines were shown at intervals to invited audiences. Members of the Pittler organisation in Germany were present throughout the period, to give technical advice on the applications of the Pidofat machine to visiting production engineers.

Frequent demonstrations were given of a typical set-up for which this machine is particularly suitable, and the operation of the turret slide, top slides, cross-slide, and copying mechanism were explained in detail. This machine, which has already been described in MACHINERY, 95/1111—25/11/59, has been developed primarily to facilitate the turning of both front and rear faces, also the edges and bores, of flanges, roller bearing rings, pulleys, gear blanks, and similar components. It is claimed that it is well suited to short-run production on account of the simplified setting arrangements. Workpieces are usually turned on one face at the left-hand station, and then transferred by the operator to the right-hand station for turning on the reverse side. Apart from manual loading at both stations, the Pidofat machine is fully automatic in operation, the speeds, feeds and indexing movements being pre-set and then controlled by built-in electro-hydraulic equipment. It may be noted, moreover, that automatic loading and transfer equipment can be supplied for the single-spindle machine.

Each work spindle is driven independently by a pole-changing motor of either 8 or 12·2 h.p. and eight spindle speeds ranging from 56 to 1,400 r.p.m. are provided through V-belts and gear trains fitted with electro-magnetic clutches. Because the drives are independent, either spindle can be stopped, unloaded and reloaded, while machining is in progress at the other station.

In front of the left-hand spindle there is an end-working turret with three tool positions for roughing, boring and finishing operations. The turret is indexed hydraulically and positively locked in position. To facilitate loading and unloading of workpieces there is a fourth turret position, which permits free access to the chuck. Coolant is conveyed through internal passages in the turret body to the tool stations.



Front view of a Pittler 2-spindle chucking automatic set-up for boring, facing and turning operations on high tensile steel crown wheel blanks. A component is completed every 69 sec.

Above the spindle there is a tool-slide which can be moved vertically and longitudinally in accordance with a pre-set programme, and may be fitted, if required, with hydraulically-operated longitudinal copy-turning equipment. A heavy-duty cross-slide at the right-hand spindle position is suitable for in-

ternal machining operations. Longitudinal and transverse movements can be obtained under programme control and the slide may be used for copy turning in both directions of travel. An overhead slide similar to that already described, again arranged for both vertical and longitudinal motion, is also provided for the right-hand work station.

The latest version of the Pidofat chucking automatic is arranged for programme control by means of multi-pin plugs which are internally wired in different ways to provide various pre-set circuit arrangements when inserted in multi-contact sockets on the control panels for the overhead and cross-slides. At present 10 different programmes, including copying sequences, controlled by the pre-wired plugs, can be obtained for the cross-slide, and seven programmes for the overhead slides.

The maximum traverse of the turret is 7·1 in., of the overhead slides, 3·9 in. longitudinally and vertically, and of the cross-slide, 6·3 in., for both directions. Cutting strokes are limited by adjustable stops and the turret feed rate can be independently pre-set for each tool position. Rapid traverse motions at a speed of 315 in. per min., and steplessly-variable feeds from 0·4 to 15·7 in. per min. are provided for the turret and all slides. Work up to 7·8 in. diameter can be held in the chuck and the maximum diameter that can be turned is 9·1 in.

In the accompanying illustration is shown a set-up employed for the production of a fully machined crown wheel blank for a vehicle rear axle. The workpiece, which is a high tensile steel forging, is held in a 3-jaw chuck in the left-hand spindle, and is rough- and finish-bored, and chamfered, by tools mounted at two positions in the turret. Simultaneously, a combined facing and peripheral chamfering operation is performed by two tools which are mounted at *A* on the overhead slide.

The workpiece is afterwards transferred by the operator to a Tobler expanding mandrel on the right-hand spindle *C* for the second machining cycle, which provides for simultaneous external and internal copy turning operations, the latter involving follow-on roughing and finishing cuts by two tools (one inverted) which are mounted in the cross-slide at *B*. The template from which the form is derived may be seen at *C*, with the stylus on the right. Two tools mounted at *D* on the overhead slide, and guided by a stylus and template which are not visible in the illustration, turn the face and edge of the workpiece.

With this 2-stage set-up, one component is completed every 69 sec.

Letters to the Editor

[The Editor does not hold himself responsible for the views expressed by his correspondents.]

Performance of Ceramic Tools

(*To the Editor of* MACHINERY)

SIR,—As an experienced carbide engineer I would like to comment on two points in connection with the description of the new Carborundum film entitled "The Winning Tip," which appeared in MACHINERY, 99/1106—8/11/61.

For the rough-turning of "as-cast" iron cylinder liners, the speeds and feeds quoted are well within the capacity of carbide tools. If there was a reduction of 33⅓ per cent in machining time, it does not prove the efficiency of the ceramic but indicates to an experienced engineer that the correct grade of carbide was not selected for the job.

As regards the machining of motor car cylinder heads, it is as well to note that both heads and blocks have been machined with carbide at 1,000 ft. per min., at much higher table feeds than 10 in. per min., for the last 20 years. Again it is difficult to see how machining time could have been halved and tool costs reduced by 33 per cent.

It is my personal opinion that the possibilities of ceramics have been grossly over-rated and that they have not gained ground at the expense of carbides, but have served a very good purpose in illustrating how much many users have to learn concerning the application of grades of tungsten carbides.

R. N. COOK, M.I.Prod.E., A.M.I.Mech.E.

Kenilworth.

Film on Tool Steels

A colour film entitled "Tool and Die Steels" was recently shown in London by Jessop-Saville, Ltd., Brightside Works, Sheffield. With the exception of the commentary, which was spoken by Richard Baker, the television announcer, the film has been produced entirely by the staff of this old-established steel-making organization. The film opens with a succession of shots which illustrate the use of tool steels in such operations as extrusion, stamping, pressure die casting, plastics injection moulding, compression moulding, and cold forming and trimming of sheet metal.

Various stages in the manufacture of alloy steels are then explained. Spectrographic analysis, by electronic methods, of steel samples during the melting stages is shown, and there follow sequences that indicate how the as-cast structure of the steel may be modified by hot forging. Finally, attention is drawn to the inspection of the finished material by ultrasonic methods.

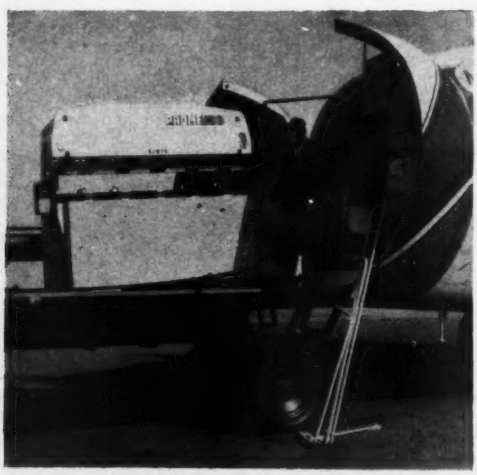
The running time is 25 min., and the film is available free on loan, in the 16-mm. size, on application to the publicity department of the company.

NEWS OF THE INDUSTRY

London and the South

ELGAR MACHINE TOOL CO., LTD., 172-178 Victoria Road, Acton, London, W.3, together with Press & Shear Co., Ltd., and Gate Machinery Co., Ltd., report an increased turnover during the past year as compared with the previous period. Activities of the Group have recently been extended by the formation of a Plastics Division, which is concerned with plastics machinery, and, amongst others, holds agencies for Illig vacuum forming equipment, Flesch injection moulding machines, and Kleinewefers extruders and calenders.

Continued interest is reported in Droop & Rein copy milling machines and we understand they are being widely employed for the production of integrally stiffened aircraft parts from high tensile steel and other metals. It was also reported by the Press & Shear Co. that a number of Bohner & Kohle hydraulic spinning and flow forming lathes was recently supplied to a factory for the quantity production of spin dryer drums used in domestic equipment.



Air transport is frequently employed to ensure prompt delivery of Promecam hydraulic press brakes

Broadway Equipment, Ltd., were taken over recently and the agency for Promecam hydraulic up-stroking press brakes is now handled by the Press & Shear Co. It was noted that press brakes are generally transported to this country by air, in order to expedite delivery, and we were informed by Elgar that consignments of Graziano lathes have also been sent from Italy by air.

Gate Machinery Co., Ltd., are to hold a demonstration of machine tools from December 11 to 15 and Elgar Machine Tool Co., Ltd., and Press & Shear Co., Ltd., will demonstrate various turning processes and press-work operations during the period February 5 to 16, 1962.

CATMUR MACHINE TOOL CORPORATION, LTD., 103 Lancaster Road, Ladbroke Grove, W.11, are still busy with orders for British-built Moore-Catmur No. 2 jig grinding machines which have a grinding capacity up to 5 in. diameter, or, when provided with an adapter, up to 8 in. diameter. These machines, it is claimed, are capable of removing stock at exceptional speed while maintaining accuracy of hole location and size, and several have recently been exported to Egypt, Denmark, Japan, and other overseas destinations. The No. 3 Moore jig boring machine, and the smaller No. 1½ machine are in good request, and a growing interest is reported in the Moore universal measuring machine, with a capacity of 11 in. by 18 in. by 18 in.

The demand for Bridgeport turret milling machines of British and American manufacture is well maintained, and orders are in hand for pivot-burnishing machines, multiple-spindle drilling machines, milling machines, and riveting machines by Steinel. Two versions of the Vero Auto-Drill, designated No. 5625 and 3125, and both provided with Airmec Autoset electrically-operated positioning equipment, can be supplied.

H.S.S., LTD., 25 Church Road, Teddington, Middlesex, are still very busy with orders for bright drawn mild steel and alloy steels which are generally available in some 170 sizes. During recent weeks, it is reported, the deliveries of steels from manufacturers have improved, and a wider range of En. grades is available from stock. Bosch power tools and attachments are in demand and there is

a steady call for equipment suitable for cutting such materials as rubber and foamed plastics. Simmonds nuts, and a wide range of nuts and bolts with Unified, B.S.W., B.S.F., and other thread forms, are stocked for delivery to customers over an extensive area of Southern England.

DORMAN MACHINERY SALES, LTD., Woodside Hill, Chalfont St. Peter, Bucks., report considerable interest in the Salome Synchromat programme-controlled automatic multi-tool and copying lathes, also in Qualitex spark grinding and boring machines and De Valliere type H.130.C precision lathes, numbers of which are now installed in the works of leading companies engaged in the production of precision parts of various types, including aircraft components.

The company is also receiving a good volume of enquiries for the Lees-Bradner rotary gear hobbing machines, which are extensively employed by companies producing automobile components.

F. W. HERRIDGE.

Burnley and District

ROBERT SCAIFE (COLNE), LTD., Clarence Street, Colne, report a steady demand for the range of arbors, collet chucks, adapters, and associated equipment which they make. The company's products also include a range of machine vices, the sales of which, it is stated, continue at a satisfactory level. Many of the current orders for arbor equipment and machine vices are for export. In addition, the company undertakes the construction of jigs and fixtures, and several were in progress at the time of our visit. Among recently-installed machines may be mentioned a Cleveland automatic, a Cincinnati centreless grinder, and a hydraulic broaching machine.

ASQUITH ELECTRICS (COLNE), LTD., Walton Street, Colne, are concerned mainly with the production of control panels and switchgear for the machine tools built by the other member companies of the Asquith Machine Tool Corporation. Control panels are also made and supplied to other engineering companies, including textile machinery makers, and hoist and lift manufacturers.

In addition, the company specializes in the production of electrical devices for the control of yarn quality in the textile industry. A high level of output is being maintained and capacity is continually being increased to meet the growing demands for the company's products. A complete range of electrical component parts is manufactured for inclusion in general panel construction and for sale as separate items to the electrical and engineering trades. Plastics moulding, die casting, punching and pressing, and steel cabinet construction are undertaken on the premises. Further expansion and extensions are planned by the company.

Recent additions to the plant have included an 8-ft. by 8-s.w.g. Keetona guillotine; an 8-ft. by $\frac{5}{8}$-in. Barnes hydraulic brake press; a Ward No. 4 capstan lathe; a Smart & Brown model L capstan lathe; and a Centec milling machine; also other sheet metal working machinery, among which may be noted forming, nibbling and rolling equipment.

RIGG BROS., LTD., 113 Albert Road, Colne, are busy with the production of jigs, tools, and fixtures, and have contracts in hand for the supply of these items to large engineering firms in various branches of the industry. During a tour of the works we were shown a range of press tools in the course of production, and multi-stage types were in evidence as well as single-stage compound designs and simple fly-press tools. A set recently completed included a 6-stage follow-on tool. The company is making a special machine, designed by the customer, for a rolling and swaging operation. Apart from the design and production of tooling equipment, several services are offered to the trade, for instance, jig boring and heat treatment. A new Jones & Shipman surface grinder with a 27-in. by 12-in. table is due for delivery in January.

DYSON BROS. (PRECISION ENGINEERS), LTD., Dale Street, Brierfield, are occupied wih contract precision machining for the aircraft industry. The company is principally concerned with the production of prototypes and experimental work, and for this reason, the plant and staff are as versatile as possible. Whereas the greater part of the production capacity is devoted to such work, the construction of jigs and fixtures, and special-purpose machinery, is also undertaken. One of the current contracts involves the supply of equipment for work-handling on a transfer-line in the motor car industry. Machines recently installed include two Stanley lathes with 10-ft. beds.

BURCO, LTD., Burnley, who are makers of domestic electrical appliances, report a satisfactory level of orders for their products, and in pursuance of their policy of striving for greater efficiency, have added more automatic machines to the plant. Several, including machines for cutting-off and forming bare connectors, and for winding and testing electric elements, have been entirely designed and built by the company. Other machines have been purchased complete or modified, as has the large amount of work-handling equipment provided. Special mention may be made of an induction-brazing machine constructed recently by combining various pieces of standard equipment.

A British Bellows 6-station air-operated indexing table has been equipped with work-clamping fixtures and mounted on a Burco-built cabinet. Pneumatic control gear built into the cabinet imparts an automatically-timed rise and fall motion to the table, whereby workpieces held in the fixtures are passed into, and withdrawn from, the heating coil (which is mounted with its axis vertical). The coil is controlled by means of a Delapena type 69 unit installed at the rear of the machine.

THOMAS ASHWORTH & CO., LTD., Sycamore Avenue, Burnley, are now in full production in their new works and report a very substantial demand for their services as die casters. Numerous orders are in hand for both gravity and pressure castings, in most of the alloys handled by the firm. The company's range of textile beams (large bobbins), made in aluminium, is well established, and the production of items from this range occupies a large section of the gravity shop and of the machine shop. In the latter department, a Richards boring and turning mill with 36-in. table has recently been installed, also a Dean, Smith & Grace lathe of 10¼-in. centre height which will admit 7 ft. 6 in. between centres. A Bridgeport type J milling machine has been added to the tool-room plant.

ROSEGROVE ENGINEERING CO., LTD., Vulcan Works, Accrington Road, Burnley, are fully occupied with the construction of a variety of special-purpose conveying equipment for a number of industries. The company undertakes the design and production of such equipment to suit individual requirements, and schemes for many unusual purposes have been carried out. Vertical storage units are another speciality, and these plants are also made for specific applications. Fabrication work is undertaken in mild steel, stainless steel, and aluminium, also profile cutting on a Bison multi-head machine. A large amount of ducting is made, much of it on a contract basis.

Formed about a year ago, the company has expanded rapidly and is now well established in its field. The plant has recently been augmented by the installation of an 8-ft. by ¼-in. Rushworth guillotine; a set of Barnes 8-ft. by ¼-in. bending rolls; a Pullmax ¼-in. plate-working machine with 4-ft. throat; and the Bison cutter mentioned above.

J. J. MARKLEW.

The Importance of Human Sciences

(*Continued from page* 1235)

is necessary, at present, to rely on less refined methods, such as the case study, and the sample survey. These methods tend to be slow and may not yield clear and positive results. When carefully applied, however, they can do much to increase understanding of the complex societies that exist in industry.

Those concerned with such investigations would be the first to agree that very much still remains to be done in connection with a great variety of problems. Before new work can be undertaken on an adequate scale, however, more support must be forthcoming, and for the purpose of invoking wider interest, steps must be taken to ensure that the findings of studies already completed are more widely known. In this connection, it is pointed out that it is by no means easy to bring such information to the attention of those who are in the best position to take advantage of it. This booklet, which deserves to be widely studied, should, however, do much to stimulate interest in the human sciences which are evidently destined to play so important a part in industrial activities.

Gas Council Film on Heat Treatment

" Precision for the Mighty " is the title of a new colour film which has recently been added to the library of the Gas Council, 1 Grosvenor Place, London, S.W.1. Examples are shown of gas carburizing and flame hardening operations, and sequences are included on the flame hardening of track links for excavators at the works of Ruston-Bucyrus, Ltd., Lincoln. Surfaces of these links subjected to the most severe wearing conditions are those of the holes for the track pin, the two heavy lugs whereby the sprocket drive is taken up, and the roller path. All these surfaces are flame hardened automatically on a Peddinghaus transfer machine in a floor-to-floor time of 5 min. This machine was fully described in MACHINERY, 94/685—25/3/59.

The film runs for 17 min. and is available free on loan in the 16-mm. size.

Personal

MR. T. H. H. SKEET, Member of Parliament for Willesden East, has accepted an invitation to serve on the Economic Policy Committee of The Machine Tool Trades Association, Brettenham House, Lancaster Place, London, W.C.2.

Obituary

SIR GREVILLE MAGINNESS.—We regret to announce the sudden death of Sir Greville Maginness, K.B.E., at his home, on November 23, at the age of 73. He was educated at Plymouth and Mannamead College, also abroad, and started his industrial career with Kynoch, Ltd., Birmingham, whom he left in 1924, when he was appointed managing director of The Churchill Machine Tool Co., Ltd. Sir Greville became chairman of the latter company in 1941, and in the same year, he was elected chairman of Roneo, Ltd. In addition to his activities in connection

with these companies, he was also a director of the Iron Trades Employers' Insurance Association, and of many other companies, and at the time of his death was deputy chairman of Tube Investments, Ltd.

Sir Greville was closely connected with the machine tool industry in this country, and was president of the Machine Tool Trades' Association from 1941 to 1943, also a member of the Machine Tool Advisory Council, Ministry of Supply, from 1945 to 1961. He was president of the Russo-British Chamber of Commerce from 1938 until he death, president of the Engineering and Allied Employers' National Federation from 1944 to 1946, and president of the British Employers' Confederation from 1946 to 1950. He was a remarkably successful negotiator in the fields of business and labour relations, and had a wide range of personal interests. Knighted in 1947, Sir Greville was created a K.B.E. in 1953. He leaves a wife and a daughter.

MR. H. WOODHALL. It is with regret that we record the death of Mr. H. Woodhall. He had been an executive of F. J. Edwards, Ltd., 359-361 Euston Road, London, N.W.1, for more than 25 years and was well known in the engineering and machinery merchanting field throughout the country.

MR. K. L. OLIVER. We regret to report the death, on November 18, at the age of 50, of MR. Kenneth Lloyd Oliver, general manager of the Machine Tool and Tool Divisions of David Brown Industries, Ltd., and a director of the latter company. He was educated at Altrincham Grammar School, and served his apprenticeship with Churchill Machine Tool Co., Ltd. Subsequently, he worked for short periods with Linotype & Machinery, Ltd., Altrincham, and the Pressed Steel Co., Ltd., Oxford, before joining Muir Machine Tools, Ltd., Sherborne Street, Manchester (later the David Brown Machine Tool Division) as assistant chief draughtsman, in 1937.

Shortly after the David Brown organization acquired the company in 1944, Mr. Oliver was appointed factory manager. He became general manager of both the Machine Tool and Tool Divisions in 1956, and was appointed a director of David Brown Industries, Ltd., in November, 1959. He was responsible for the negotiation and planning which led to the removal of the entire plant of the Machine Tool Division from Sherborne Street to more extensive premises in Ashburton Road, Trafford Park, Manchester, during the 1961 holiday period.

An active member of Admiralty-Vickers Gearing Research Association since its inception, Mr. Oliver assisted the British Standards Institution in establishing standards for turbine gearing. He also served on the War Damage Assessment Committee and was a member of the Manchester Association of Engineers.

Married in 1937, Mr. Oliver leaves a widow, two sons and a daughter.

Mr. K. L. Oliver

MACHINERY'S ENQUIRY BUREAU

For many years MACHINERY has provided an enquiry service not only for subscribers and advertisers but for all engineers in need of such information as the names of makers—or their agents—of machines or equipment for performing particular operations, suppliers of various classes of material, firms with facilities for undertaking certain types of work, owners of trade names, and agents for foreign machine builders. If you have such a problem write (MACHINERY, Enquiry Bureau, Clifton House, 83-117 Euston Road, London, N.W.1) or telephone (Euston 8441, 2 lines). This service is, of course, entirely free.

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29/11/61

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Industrial Notes

VICKERS SPERRY RAND LIMITED is the new title which has been adopted by the company formerly known as Stein Atkinson Vickers, Hydraulics Ltd. The address is New Lane, Havant, Hants.

WATTS REGULATOR CO., U.S.A., have established a divisional office at Dunkirk Mill, Woodchester, Stroud, Glos., to provide an improved service in connection with their pneumatic specialities which include filters, regulators, and lubricators, and Hydronic plumbing and heating equipment.

INDUSTRIAL DIAMOND SALES.—The Industrial Diamond Information Bureau, 2 Charterhouse Street, London, E.C.1, report that sales of bort in Europe totalled 1,766,668 carats in 1958, 2,233,231 carats in 1959, and 4,441,669 carats in 1960. It is stated that there was a further increase in sales for the first 9 months of 1961.

BOROUGH POLYTECHNIC, Borough Road, London, S.E.1, announce that owing to increased demand for their Higher National Diploma course in mechanical and production engineering they are offering an alternative entry date to the first year of the course in January as well as in September. The new first year course will begin on January 11, 1962, and end in July.

BRITISH WELDING RESEARCH ASSOCIATION, Abington Hall, Cambridge, have made a number of important changes as regards internal administration. These changes, it is stated, will have the effect of extending the scope of the services provided for industry, and, at the same time, will enable fundamental work, particularly in arc physics, to develop unfettered.

ELGAR MACHINE TOOL CO., LTD., 172-178 Victoria Road, Acton, London ,W.3, have been appointed exclusive distributors for the plastics and rubber processing equipment made by Joh. Kleinewefers Sohne, Krefeld, Germany. The range includes extrusion machines and complete extrusion plants for pipes, profiles, and sheeting, also calendering plant, mixing mills, and embossing rollers.

THE UTILIZATION OF THE BLIND IN INDUSTRY.—An afternoon conference on this subject organized by the South London Productivity Association will be held on December 5, starting at 2 p.m. in The Council Chamber, The Federation of British Industries, 21 Tothill Street, London, S.W.1. The fee for the conference is 21s. and applications for tickets should be addressed to Mr. A. K. Haskins, A.M.I.Prod.E., M.Inst.W.S., Borough Polytechnic, Borough Road, S.E.1.

BOVING & CO., LTD., Villiers House, 41-47 Strand, London, W.C.2, through their Australian subsidiary company, have received an order for eight vertical Francis turbines of 130,000 h.p. for the Murray I power station. These turbines will operate under a maximum gross head of 1,719 ft. The order, of a total value in excess of £1,500,000, also covers eight rotary valves of 5 ft. 4 in. diameter, of Boving special design, and pressure relief valves.

THE BUILT-IN VACUUM CLEANER CO., LTD., 93 Black Lion Lane, London, W.6, will in future make and market in the United Kingdom and on the Continent, the built-in vacuum cleaning machine formerly produced under the name Dustmaster by SIR GEORGE GODFREY & PARTNERS (INDUSTRIAL), LTD. This machine will in future be known as the Vacuumaster. The former company, in conjunction with the latter, can now offer in the domestic market a range of 11 machines from 800 watts to 30 h.p.

TUFNOL, LTD., Perry Barr, Birmingham, 22B, have asked us to point out that their film "Tufnol in the Making" which shows the processes involved in the manufacture of laminated plastics material, is available for showing at technical colleges, and at meetings of engineering associations and amateur societies. Copies of the film may be obtained on loan from the above address or from the Central Office of Information Film Library, Government Building, Bromyard Avenue, London, W.3.

IMPERIAL CHEMICAL INDUSTRIES, LTD., Imperial Chemical House, Millbank, London, S.W.1, have set up a plant at Widnes, Lancs., for the production of 111-trichloroethane solvent which will be sold under the trade mark Genklene. It is non-inflammable and of medium volatility and low toxicity, and is claimed to be specially suitable for cold cleaning, for example of machinery *in situ*. The solvent can be applied by wiping, dipping, or spraying. It is anticipated that Genklene will also find application as a solvent in adhesive compositions and in the formulation of cutting oils.

GEORGE RICHARDS & CO., LTD., Broadheath, Altrincham, Cheshire, a member company of Staveley Industries, Ltd., have a very full order book for their complete range of machine tools. During a recent visit to their works we saw a vertical turning and boring mill, with a 22-ft. diameter table, in the final stages of erection. This machine has been built for a new works at Durgapur, India, and incorporates two angularly adjustable tool rams. Large floor type horizontal boring machines were being built, one of which had a 6-in. diameter traversing spindle, with power-operated facing head. These machines are provided with hydrostatic slideways for the columns.

STANDARD FOR METAL WASHERS.—The British Standards Institution has issued B.S. 3410:1961 covering metal washers for general engineering purposes. Tables for plain washers have hitherto been included in standards for bolts, screws, and nuts, but it was felt that these provisions were not in accordance with users' requirements or current practice. The new specification provides for metal washers in a greater variety of diameters and thicknesses to meet what experience has shown to be the greatest popular demand. Both bright and black washers are covered.

Copies of B.S. 3410 can be obtained from the British Standards Institution, Sales Branch, 2 Park Street, London, W.1. (Price 6s., postage extra to non-subscribers.)

Machine Tool Display in Japan

The Board of Trade and the Machine Tool Trades Association will stage a display of British machine tools at the Japan International Machine Tool Fair to be held in Osaka from October 10 to 21, 1962. On the official stand, which will have an area of 12,000 sq. ft., 26 British firms will be showing their products, and there will also be a trade enquiry bureau staffed by the M.T.T.A. At least 19 other British machine tool builders will be displaying products on the stands of their agents.

Books Received

SAFETY AND HEALTH IN INDUSTRY, 1961 edition. The Industrial Health & Safety Centre, 97 Horseferry Road, Westminster, London, S.W.1. 150 pp. Copies obtainable free.

There are seven major sections in this publication, concerned with machine guarding, industrial health engineering, personal protection, material handling, housekeeping and maintenance, fire protection, and general matters, and more than 100 illustrations are included. It is intended to provide a guide to basic safety, health, and welfare in industry, for those who are anxious to reduce losses which at present amount to some 20,000,000 man-days annually.

DIGITAL DATA. By D. S. Evans, M.I.E.E., Hilger & Watts, Ltd., 98 St. Pancras Way, London, N.W.1. 82 pp. [Price 15s.]

Concerned with the derivation and reduction of digital data for analysis and process control, the book provides an insight into the use of data handling-handling equipment. In his preface, the author points out that development in the field of data handling is rapid, and explains that whereas he has chosen, as far as possible, instruments and systems that are either in production or have been made in prototype forms, they are likely to be changed in detail as new techniques and improvements suggest themselves. Chapters are devoted to incremental scales, digital counting devices, direct reading from coded scales, ancillary equipment, and system arrangements and applications.

Coming Events

INSTITUTION OF PRODUCTION ENGINEERS. *Peterborough Section.* December 5, at 7.30 p.m., at F. Perkins, Ltd., Conference Room, Peterscourt, Peterborough; lecture on "Non-destructive Testing and Production Engineering," by J. F. Hinsley. *London Section.* December 7, at 7 p.m., at the Royal Aeronautical Society, 4 Hamilton Place, W.1; lecture on "The Assistance the Production Engineer can obtain from the Cost and Financial Accountant," by J. F. Hull, B.Sc. *Leeds Section.* December 11, at 7 p.m., at the Hotel Metropole, King Street, Leeds, 1; lecture on "Grinding and Precision Machining Techniques," by H. F. Plaut. *Coventry Graduate Section.* December 7, at 7.30 p.m., in the Courtauld Lecture Theatre, Lockhurst Lane, Coventry; lecture on "Problems Associated with the Export of Machine Tools," by C. E. Middlemiss. *Nottingham Section.* December 5, at 7.30 p.m., at the Co-operative Educational Centre, Broad Street, Nottingham; lecture on "Recent Developments in the Soviet Union," by Dr. D. F. Galloway, B.Sc. *Western Section.* December 6, at 7.30 p.m., in the Small Lecture Theatre, University of Bristol, Queen's Walk, Bristol; lecture on "Case Studies in the Application of Work Study," by G. R. Burn.

THE INSTITUTE OF METAL FINISHING. *North-West Branch.* December 7, at 7.30 p.m., in the Regency Room, Belle Vue, Manchester; lecture on "Printed Circuits," by P. Eisler.

INSTITUTION OF ELECTRICAL ENGINEERS. *Scottish Electronics and Measurement Group.* December 5, at 7 p.m., at the Carlton Hotel, Edinburgh; lecture on "Precision Measurement," by G. H. Rayner, B.A., and A. Felton, B.Sc.

INSTITUTION OF PLANT ENGINEERS. *Peterborough Section.* December 5, at 7.30 p.m., in the Conference Room, F. Perkins, Ltd., Peterscourt, Peterborough; lecture on "Non-destructive Testing," by J. F. Hinsley. *Birmingham Section.* December 7, at 7.30 p.m., at the Hotel Leofric, Coventry; lecture on "Electronic Control in Industry with particular reference to Automation." *East Midland Section.* December 13, at 7 p.m. in the Sherwood Room, County Hotel, Theatre Square, Nottingham; paper on "Repairs by Metalock process," by Tinwell.

Scrap Metals

MIDLANDS.—The improvement in trading which had been anticipated when export of scrap was permitted has not developed to any great extent. Markets and prices abroad are not very attractive due to a general surplus of scrap of all grades.

Local steelworks are limiting their intakes of heavy steel by imposing comparatively small allocations each week, and merchants are finding it necessary to increase their stocks of processed scrap. Prices paid for oversize scrap for gas cutting and/or shearing have slightly eased, but with export markets available for heavy sections of $\frac{1}{4}$ in. minimum thickness, for re-rolling, oversize material is not entirely at a standstill.

Short heavy steel scrap also is only moving to provide for limited intakes, and surplus tonnages of lower grade sheared material are most difficult to place. Supplies of cast iron scrap are now, in general, equal to demand and a healthy trading position continues in all grades with the exception of cylinder quality iron, of which consumers are urgently wanting increased supplies. Local engine strippers are fairly busy but would welcome larger numbers of complete car and lorry engines to guarantee continuity of supplies of clean cylinder material.

Chipped turnings allocations are steady, and some improvement is evident in the demand for bushy turnings although deliveries, in general, must be low in chrome content if refusals are to be avoided. Destructor bales are hard to place in large quantities, and consumers are mainly interested in the 12-in. cube type in preference to the larger and heavier bales.

High-speed steel scrap and turnings have fallen further in price to around 1s. 6d. per lb., and 1s. per lb., respectively. These prices are for the material delivered Sheffield, subject to test.

Machine Tool Share Market

Stock markets were fairly active during the period under review, but after displaying an improving tendency at the outset, they became generally unsettled, and most sections finished on a dull note.

British Government and similar gilt-edged stocks were quietly steady for the most part, but ended with a slight setback in values.

In commercial and industrial share markets conditions were mixed, but turnover was maintained at a good level. Firm conditions gave place to easiness, and price changes on balance were irregular with declines predominating.

Among machine tool issues, Birmingham Small Arms lost 2s. at 20s. 6d; British Oxygen, 6d. at 15s.; Brooke Tool, 6d. at 7s. 6d.; Broom & Wade, 9d. at 24s. 6d.; Chas. Churchill, 1½d. at 8s. 9d.; Coventry Gauge & Tool, 1½d. at 29s. 4½d.; Craven Bros. (Manchester), 3d. at 8s. 9d.; John Holroyd "B," 1s, 9d. at 18s. 3d.; H. W. Kearns, 1s. at 21s. 3d.; and Wadkin, Ltd., 6d. at 26s. On the other hand, Clarkson (Engineers) advanced 4½d. to 6s. 10½d.; Greenwood & Batley, 2s. 7½d. to 16s. 10½d.; Noble & Lund, 3d. to 5s. 3d.; Samuel Osborn, 1s. 9d. to 55s. 6d.; and Sheffield Twist Drill, 3d. to 21s. 9d.

JOHN HARPER & CO., LTD. Interim dividend 4 per cent.

H. W. KEARNS & CO., LTD. Final dividend 12½ per cent, making, with the interim, a total distribution of 17½ per cent for the year to September 30 (same).

B. & S. MASSEY, LTD. Interim dividend 5 per cent (same).

Placement of Blind Persons

The Royal National Institute for the Blind, in co-operation with the Ministry of Labour and welfare services, inaugurated a specialist placement service in 1941. The initially small employment department gradually expanded, and in 1953 all local authorities were approached with a view to enlisting their support in establishing a national placement service, in which some 100 local authorities now participate.

The employment department of the Institute has just succeeded in making the 5,000th placement since its inception 20 years ago. The person concerned is Mr. Noel Davis, who is now employed as an operator on a special-purpose milling machine at the Southall Works of A.E.C., Ltd. Mr. Davis, aged 39, was previously a book-keeper and lost his sight completely in July, 1960. Within eight months, with the aid of the Institute's rehabilitation scheme at the Torquay Centre, and attendance at a Ministry of Labour Training School, he was able to take up this entirely new job under substantially the same conditions as a sighted person.

COMPANY		Denom.	Middle Price
Abwood Machine Tools, Ltd.	Ord.	1/-	1/3
Allen (Edgar) & Co., Ltd.	Ord.	£1	32/-
" " "	5% Prf.	£1	13/3
Arnott & Harrison, Ltd.	Ord.	4/-	12/-
Asquith Machine Tool Corp., Ltd.	Ord.	5/-	10/6
" " "	6% Cum. Prf.	£1	16/6
Birmingham Small Arms Co., Ltd.	Ord.	10/-	20/6xd
" " "	5% Cum. "A" Prf.	£1	13/-
" " "	6% Cum. "B" Prf.	£1	16/6
" " "	4% 1st Mort. Deb.	Stk.	91½
British Oxygen Co., Ltd.	Ord.	5/-	15/-
" " "	6% Cum. Prf.	£1	18/6
Brooke Tool Manufacturing Co., Ltd.	Ord.	5/-	7/6
Broom & Wade, Ltd.	Ord.	5/-	24/6
" " "	6% Cum. Prf.	£1	16/-
Brown (David) Corporation, Ltd.	5½% Cum. Prf.	£1	14/-xd
Buck & Hickman, Ltd.	6% Cum. Prf.	£1	17/-
Butler Machine Tool Co., Ltd.	Ord.	5/-	15/-
" " "	5% Cum. Prf.	£1	12/6
Churchill (Charles) & Co., Ltd.	Ord.	2/-	8/9
" " "	6% Cum. Prf.	£1	25/7½‡
Clarkson (Engrs.), Ltd.	Ord.	1/-	6/10½
Cohen (George), 600 Group, Ltd.	Ord.	5/-	10/-
" " "	4½% Cum. Prf.	£1	12/-
Coventry Gauge & Tool Co., Ltd.	Ord.	10/-	29/4½
" " "	5% Cum. Red. Prf.	£1	16/3
Craven Bros. (Manchester), Ltd.	Ord.	5/-	8/9
Elliott (B.) & Co., Ltd.	Ord.	1/-	2/9
" "	4½% Red. Cum. Prf.	£1	11/3
Firth Brown Tools, Ltd.	4% Cum. Prf.	£1	10/6
Greenwood & Batley, Ltd.	Ord.	10/-	16/10½
Harper (John) & Co., Ltd.	Ord.	5/-	8/3
" " "	4½% Red. Cum. Pref.	£1	×9/6
Herbert (Alfred), Ltd.	Ord.	£1	64/-
Holroyd (John) & Co., Ltd.	" A " Ord.	5/-	20/-
" "	" B " Ord.	5/-	18/3
Jones (A. A.) & Shipman, Ltd.	Ord.	5/-	25/-
" "	7% Cum. Prf.	5/-	4/6
Kearney & Trecker-C.V.A., Ltd.	5½% Red. Cum. Prf.	£1	8/9
" " "	Prefd. Ord.	£1	13/9
Kearns (H. W.) & Co., Ltd.	Ord.	5/-	21/3
Kerry's (Gt. Britain), Ltd.	Ord.	5/-	8/6xd
Macreadys Metal Co., Ltd.	Ord.	5/-	15/-
Martin Bros. (Machinery), Ltd.	Ord.	2/-	2/6
Massey (B. & S.), Ltd.	Ord.	5/-	11/-
Newall Engineering Co., Ltd.	Ord.	2/-	7/-
Newman Industries, Ltd.	Ord.	2/-	7/-
" "	6% Prf. Ord.	5/-	5/-
Noble & Lund, Ltd.	Ord.	2/-	5/3
Norton, W. E. (Holdings), Ltd.	Ord.	2/-	9/6
Osborn (Samuel) & Co., Ltd.	Ord.	5/-	55/6
" " "	5½% Cum. Prf.	£1	22/-
Pratt (F.) Engineering Corporation, Ltd.	Ord.	5/-	14/6
Sanderson Kayser, Ltd.	Ord.	10/-	34/9
" "	6½% Cum. Prf.	£1	16/3
Scottish Machine Tool Corporation, Ltd.	Ord.	4/-	7/9
Shardlow (Ambrose) & Co., Ltd.	Ord.	£1	55/-
Shaw (John) & Sons, Wolverhampton, Ltd.	Ord.	5/-	14/6
Sheffield Twist Drill & Steel Co., Ltd.	Ord.	4/-	21/9
" " "	5% Cum. Prf.	£1	13/3
Stedall & Co., Ltd.	Ord.	5/-	7/6
Sykes (W. E.), Ltd.	" B " non-voting Ord.	10/-	24/3
Tap & Die Corporation, Ltd.	Ord.	5/-	19/-
" " "	4½% Deb. 1961-1977	Stk.	81½xd
Wadkin, Ltd.	Ord.	10/-	26/-
Ward (Thos W.), Ltd.	Ord.	£1	66/3
" "	5% Cum. 1st Pref.	£1	13/6
" "	5% Cum. 2nd Pref.	£1	20/-
Willson Lathes, Ltd.	Ord.	1/-	2/6

The Middle Prices given in the list are in several cases nominal prices only and not actual dealing prices. Every effort is made to ensure accuracy, but no liability can be accepted for any error. * Sheffield price. ‡ Birmingham price.

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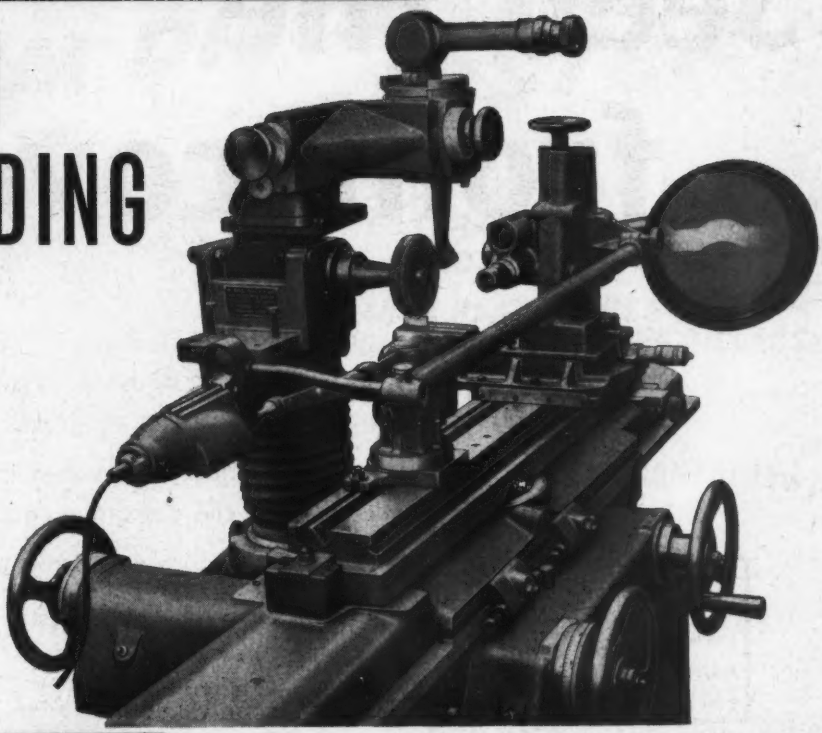

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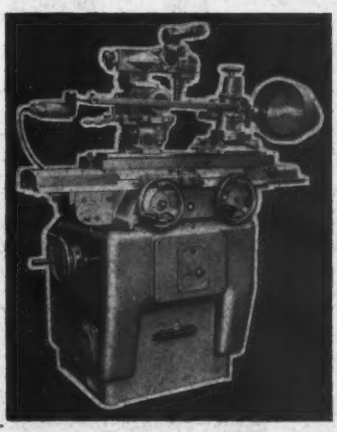

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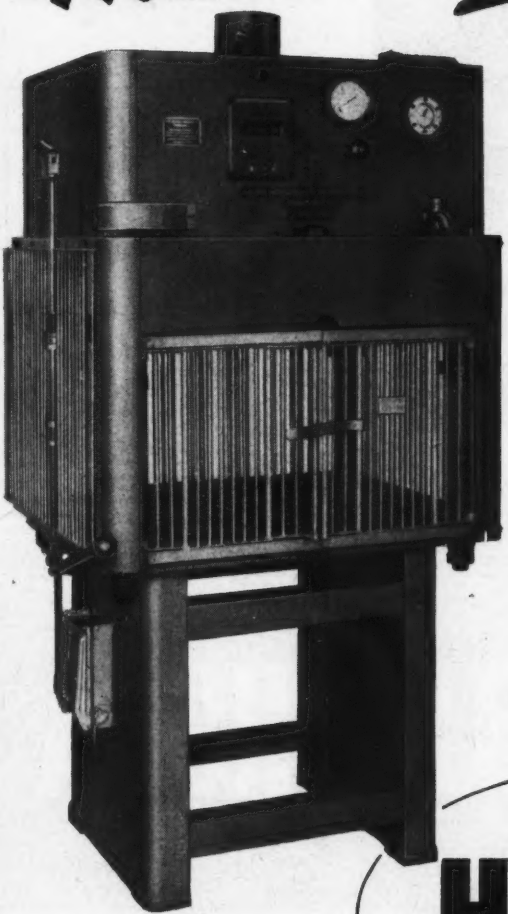

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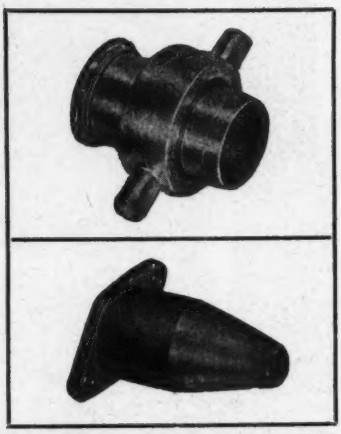

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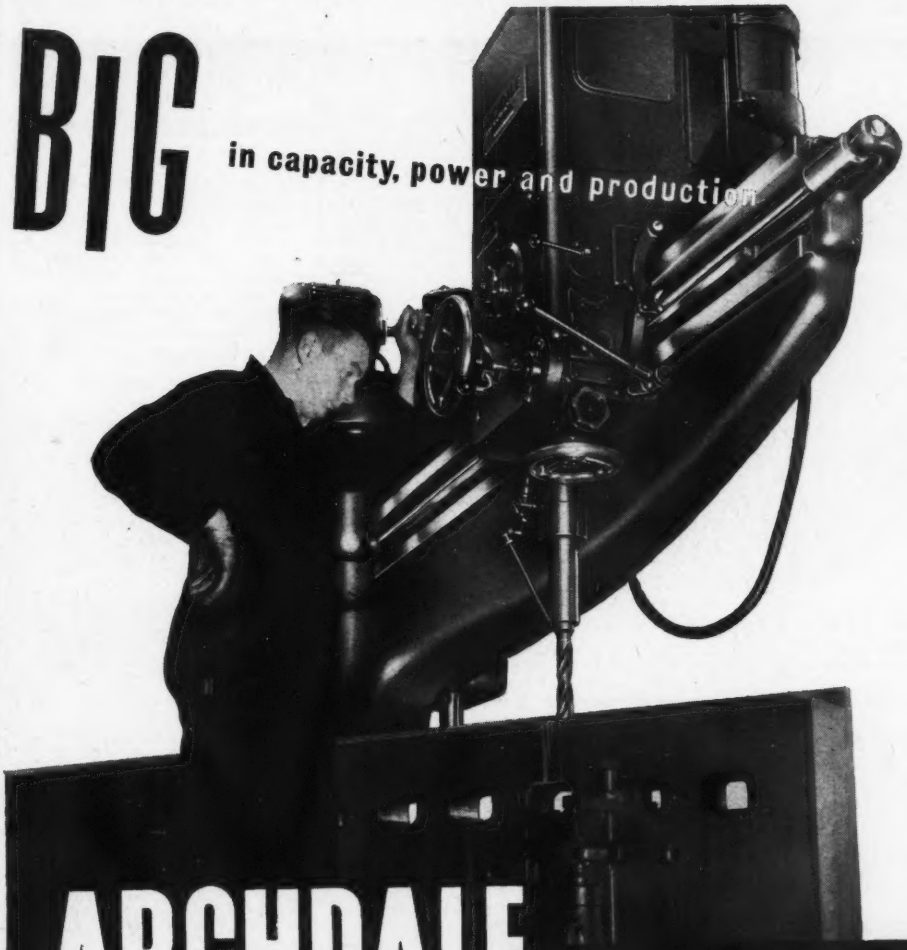

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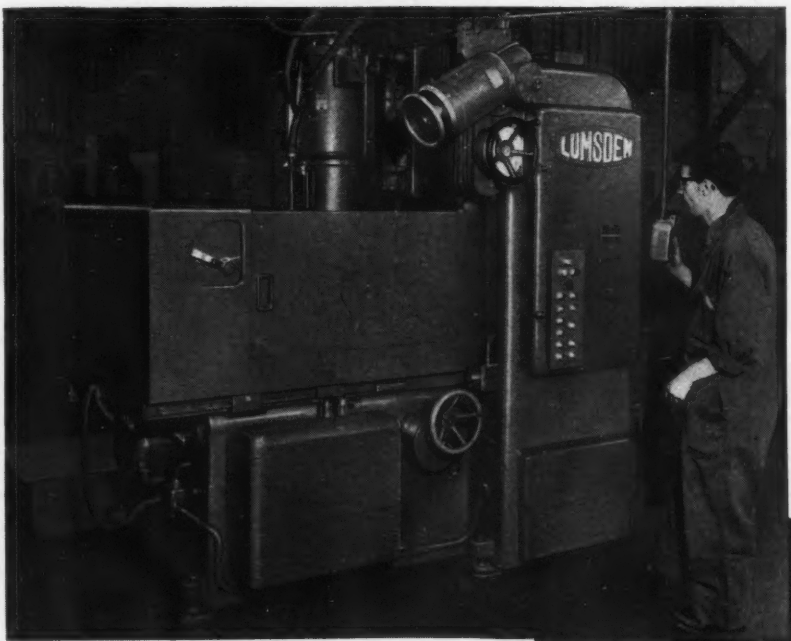

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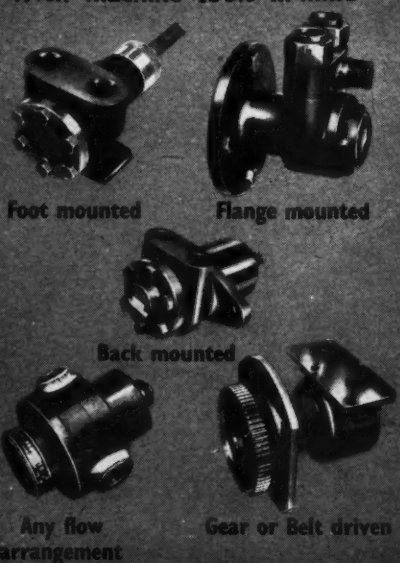

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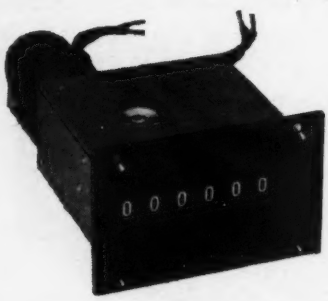

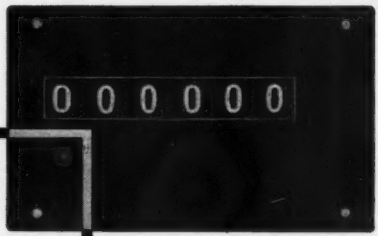

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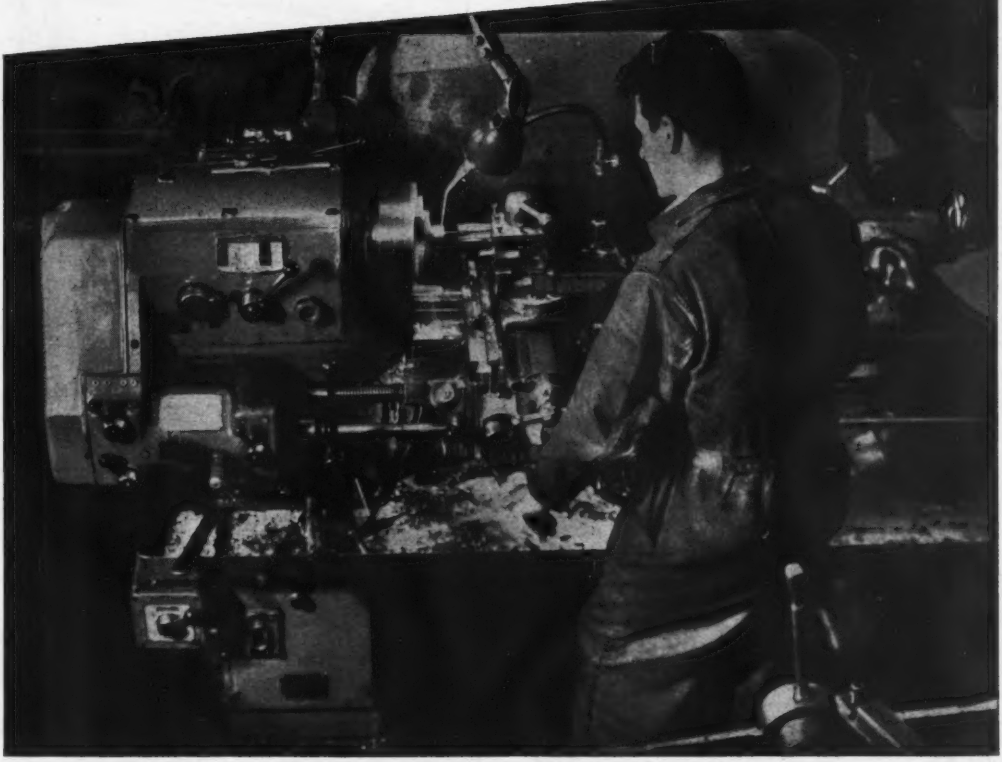

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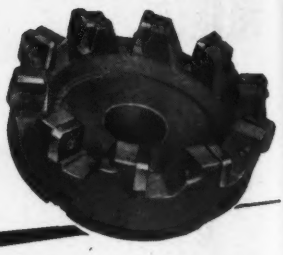

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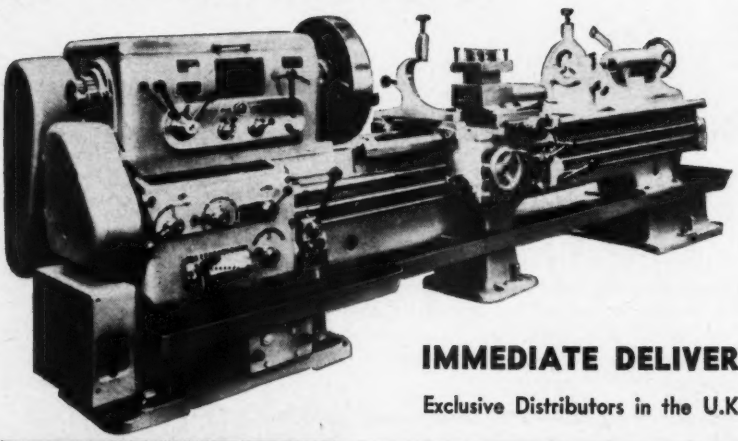
TECHNOIMPEX MODEL MVE 280 M

GAP BED HIGH SPEED LATHES



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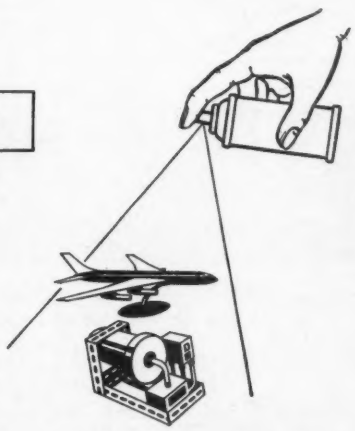

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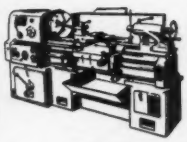

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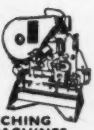

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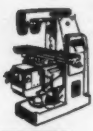

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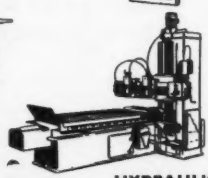

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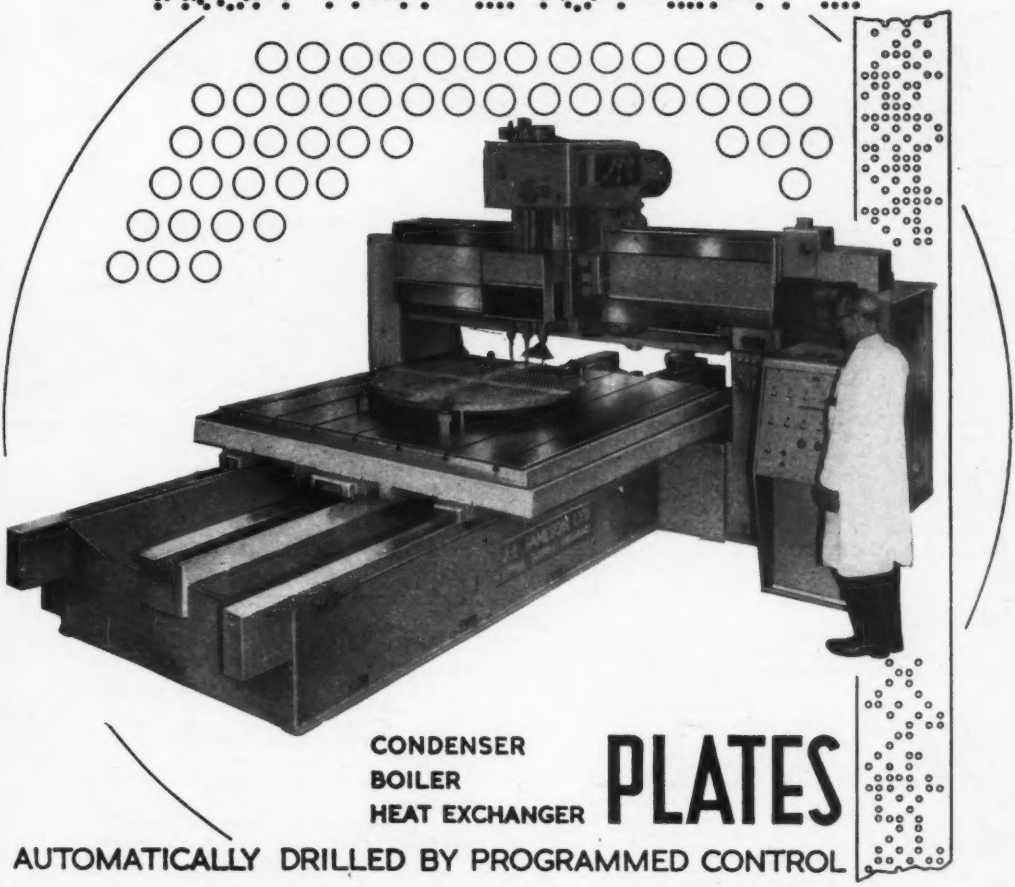

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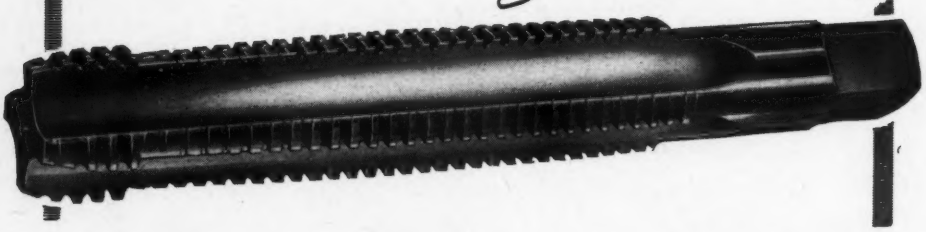

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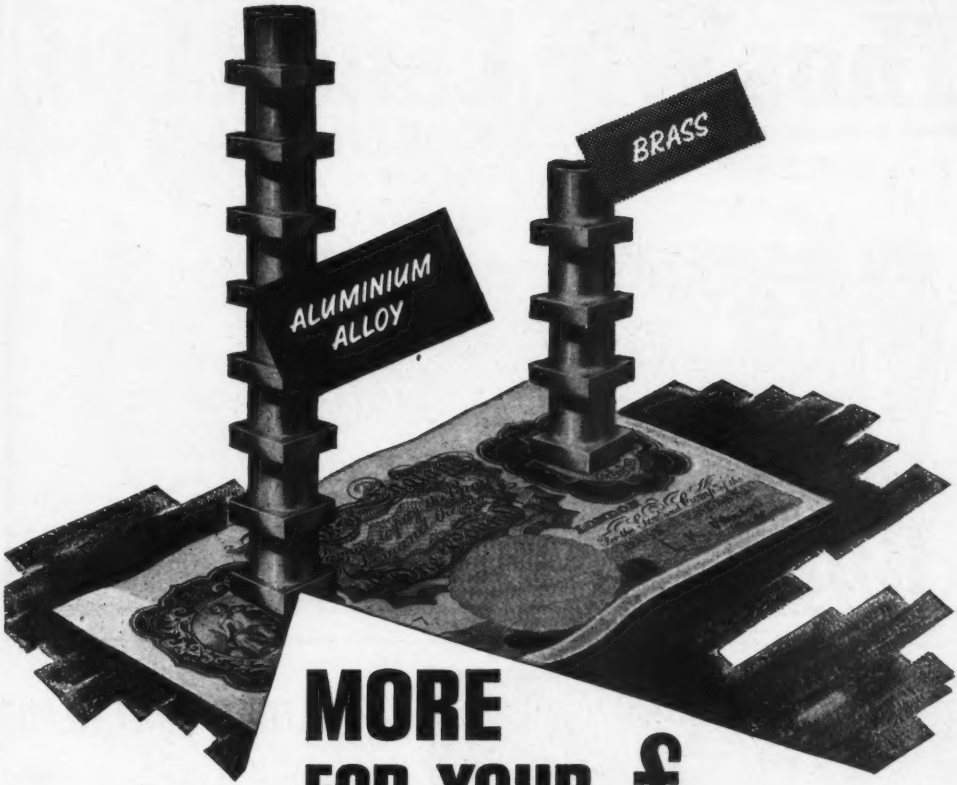

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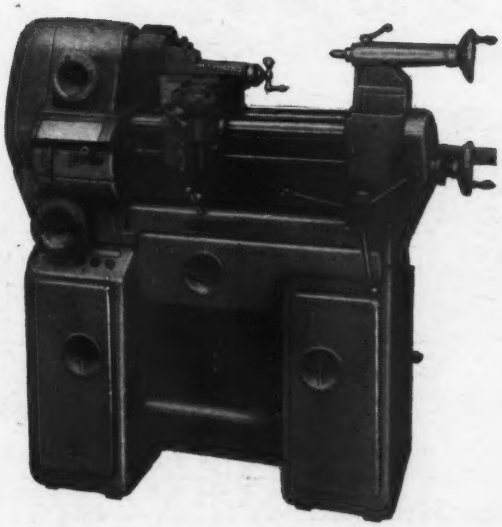

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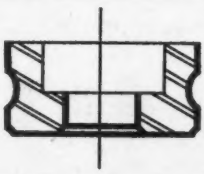

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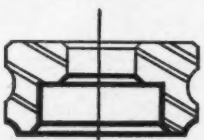

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K20 Semi-Automatic Twin-Head PRECISION LATHE...

- Work head spindle can automatically operate at high or low speeds according to preselected cutting speeds.
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- Cam accelerator reduces machining cycle time.
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- Spindle positioning device for irregular shaped components.
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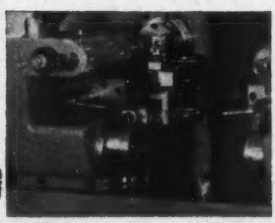

Illustration shows tailstock which is one of the many optional features available.

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THIS MACHINE DOES THE WORK OF 4

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- PUNCHING
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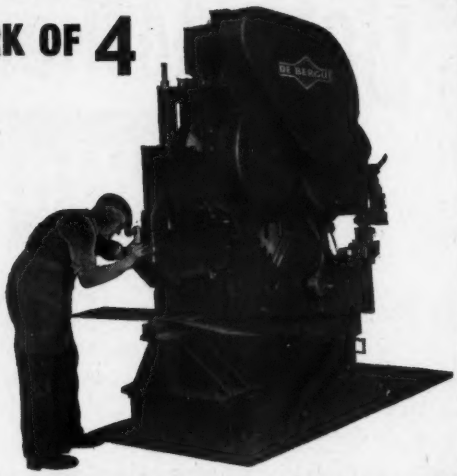
- PLATE SLITTING
- NOTCHING



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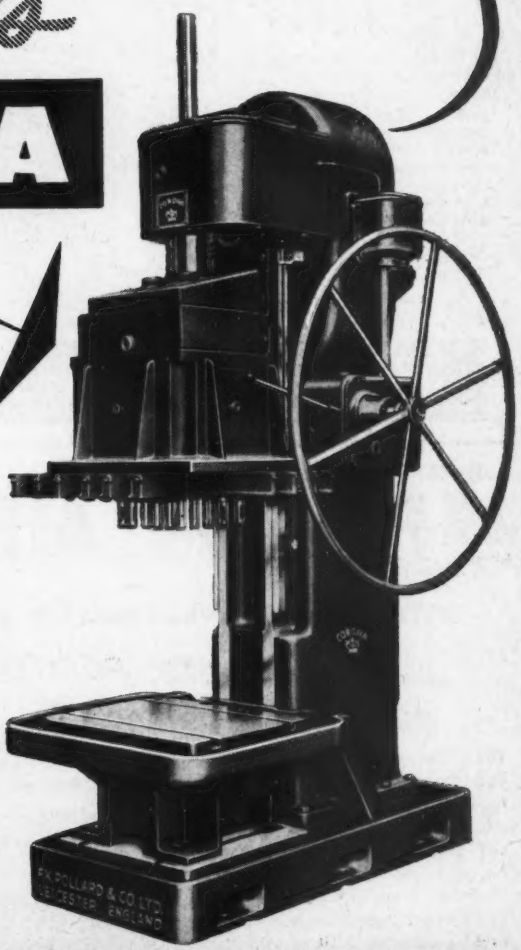
Demands CORONA



MODEL 20 MX

ADJUSTABLE SPINDLE MACHINE

Drilling area may be either circular or rectangular and all spindles are freely adjustable with individual vertical adjustment for drill wear.

Max. Drilling area (circular frame) 18in. dia.
Max. Drilling area (rectangular frame) 24in. × 14in.
Max. number of spindles No. 1 M.T. 24
Max. number of spindles No. 2 M.T. 16
Max. Drilling capacity (examples) 6—$\frac{7}{16}$in., 12—$\frac{3}{8}$in. or 18—$\frac{1}{4}$in. holes.
Area of box table .... 28in. × 22in.

A larger model is available and complete details of both machines will be sent on request.

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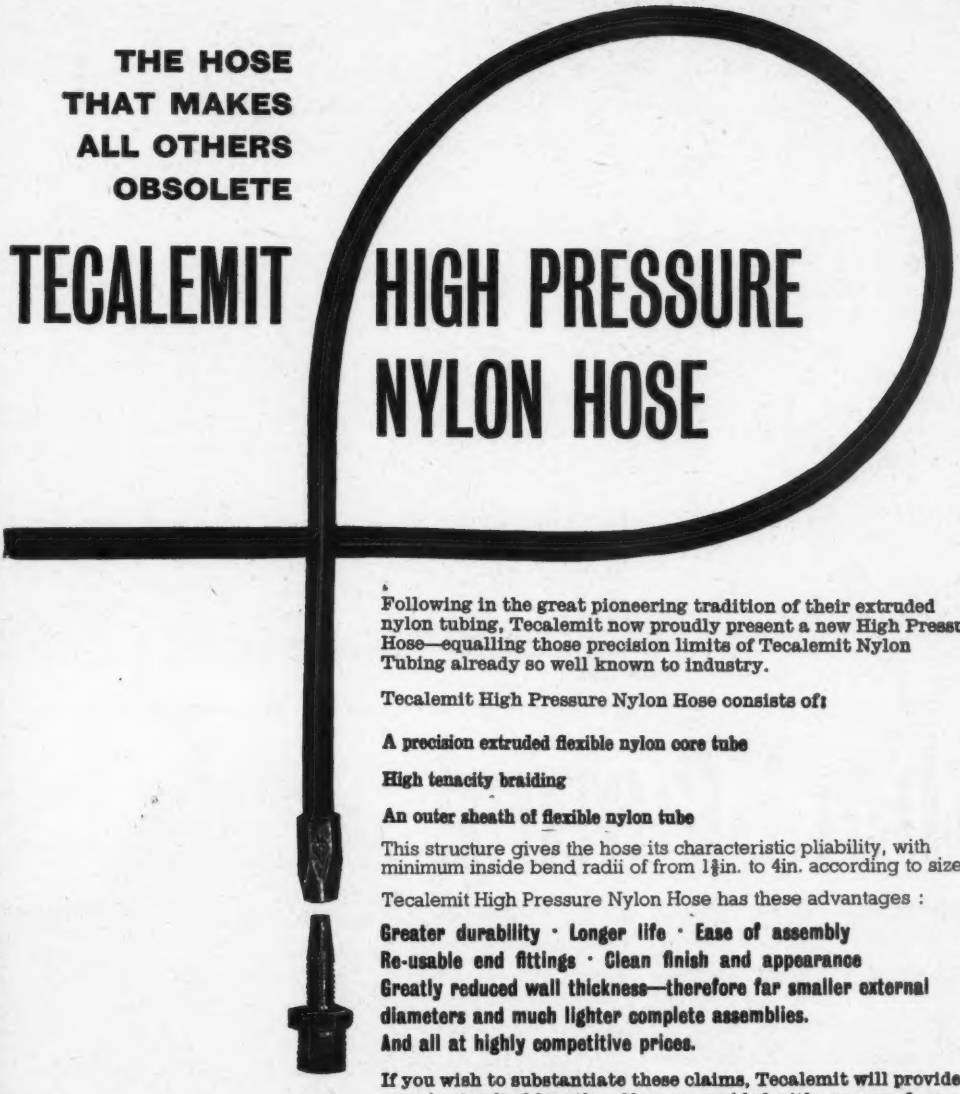

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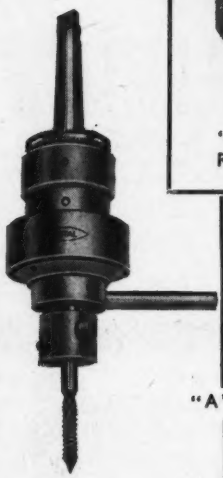

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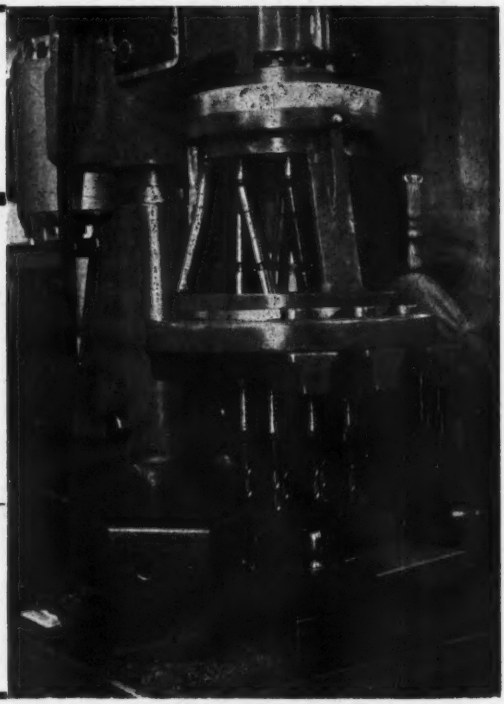

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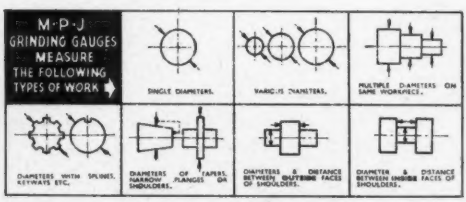

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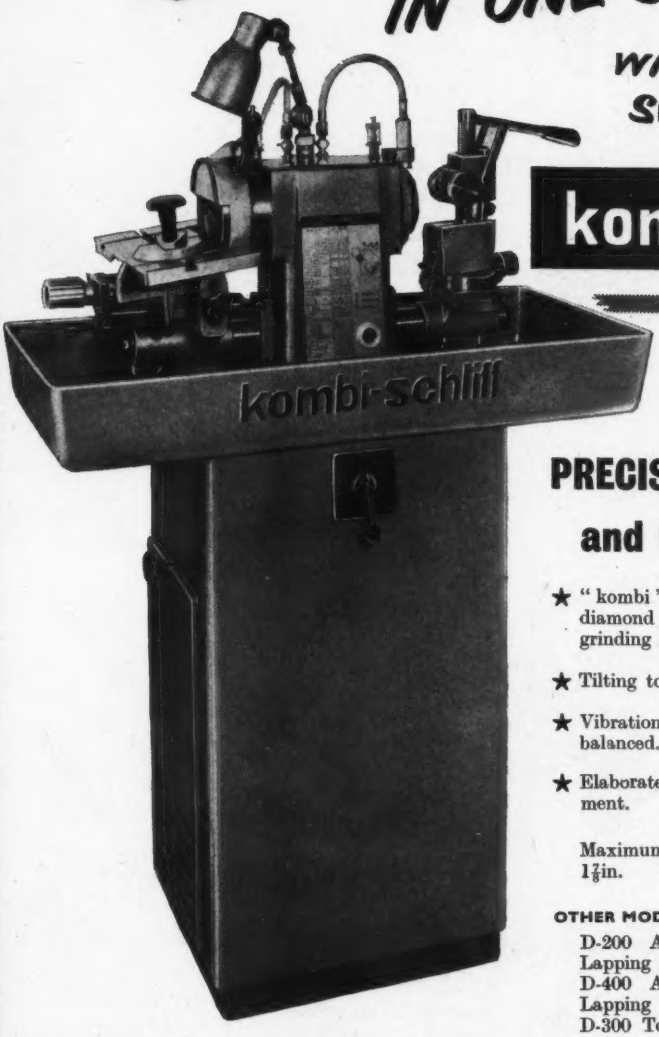

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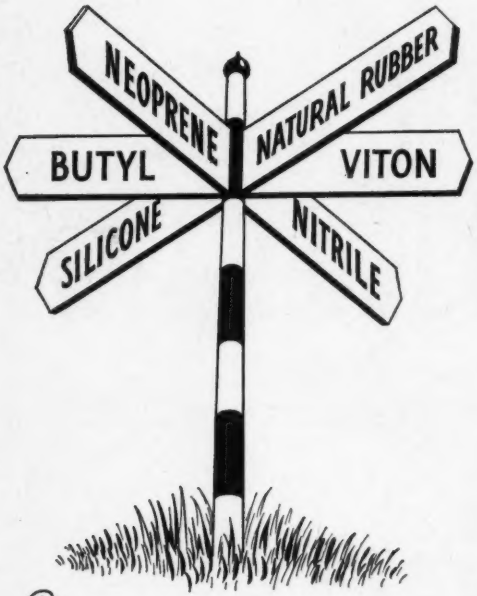

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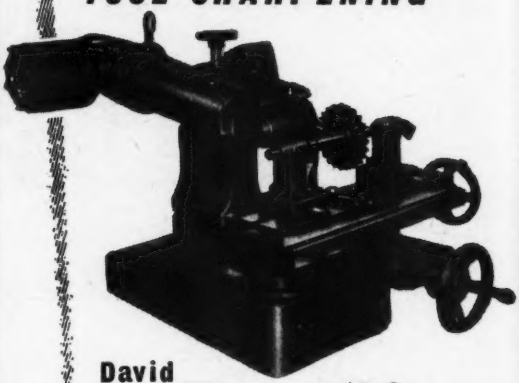

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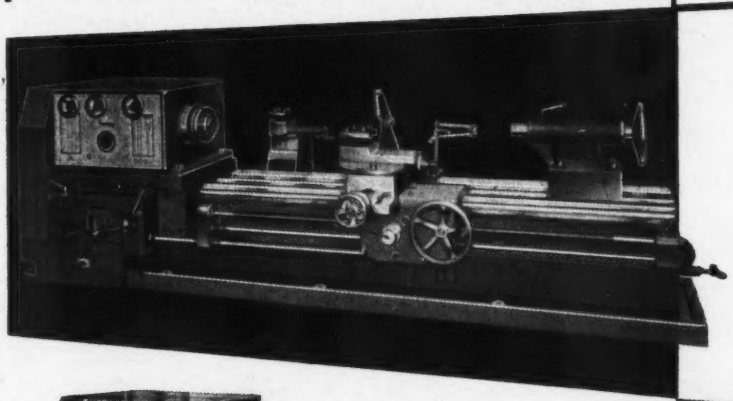

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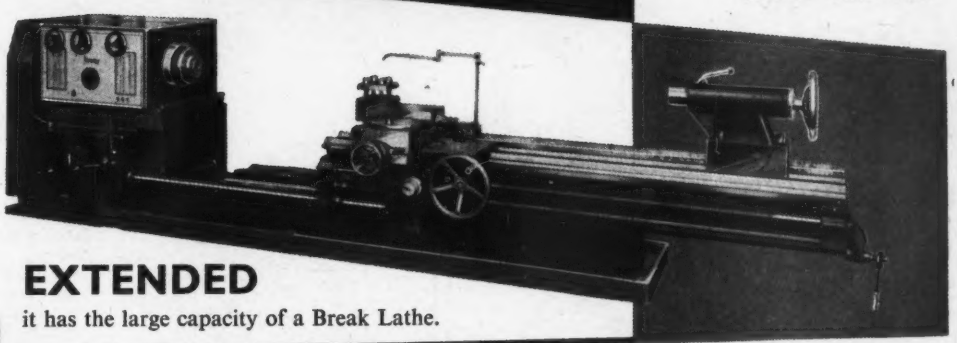

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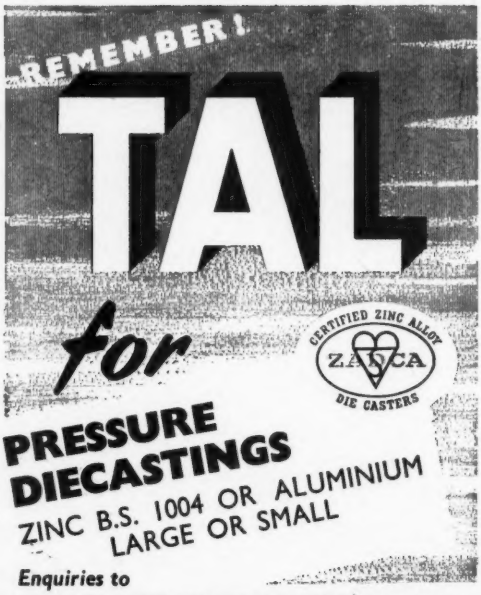

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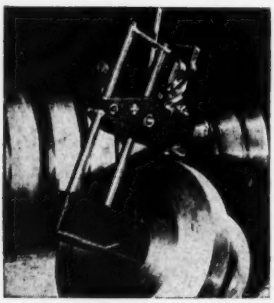

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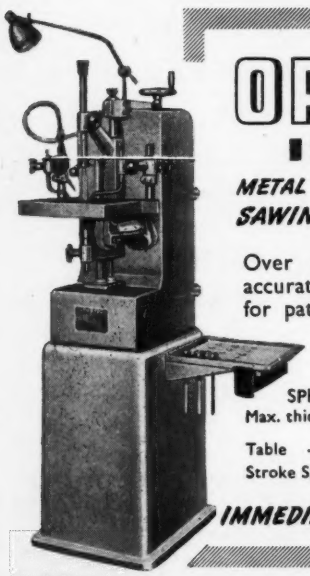

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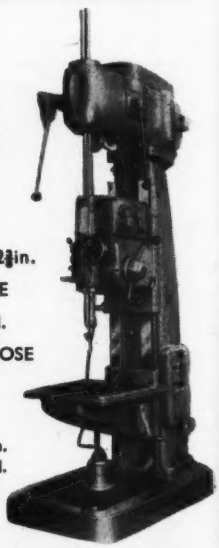

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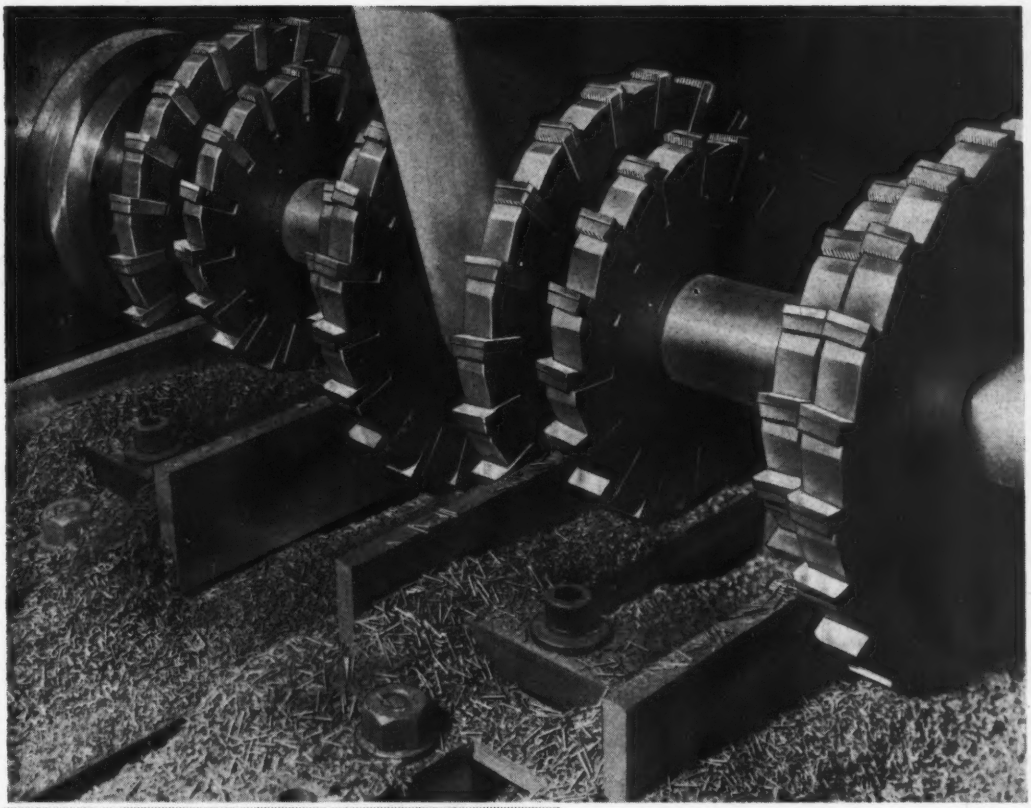

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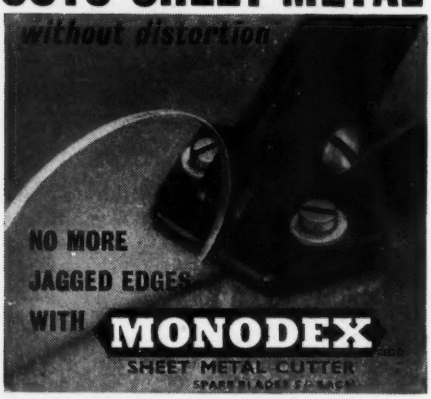

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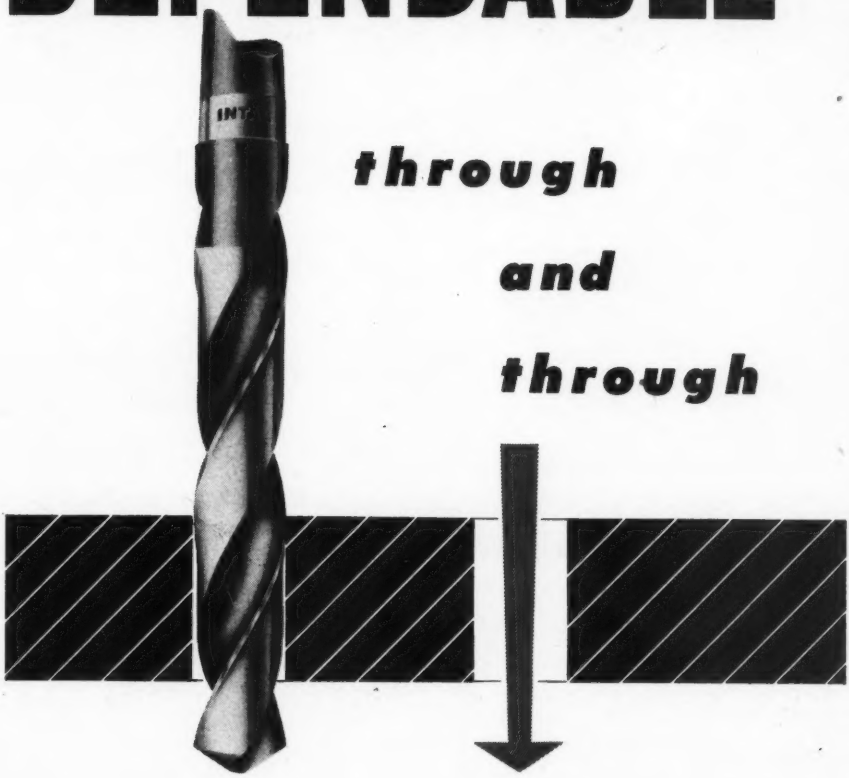

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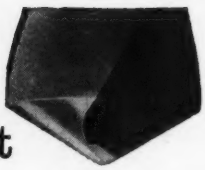

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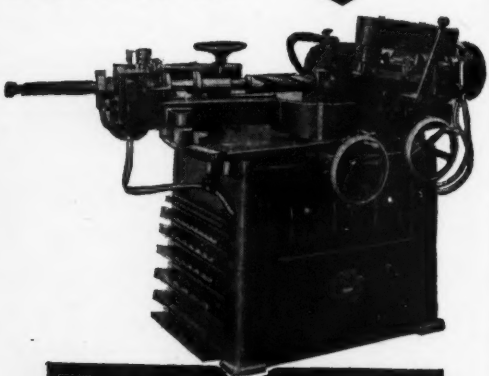

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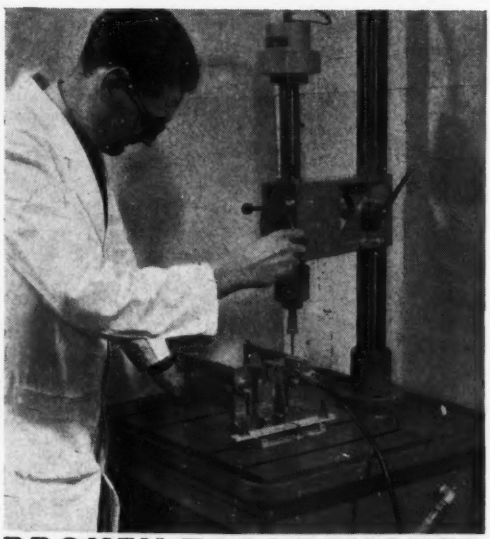

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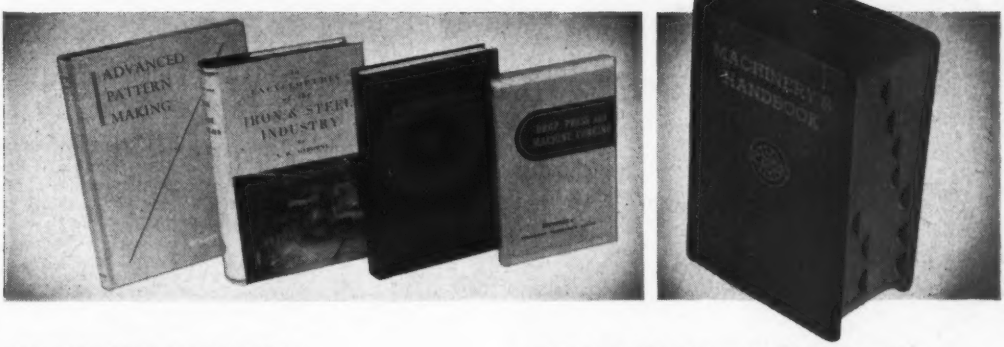

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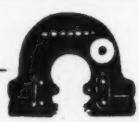

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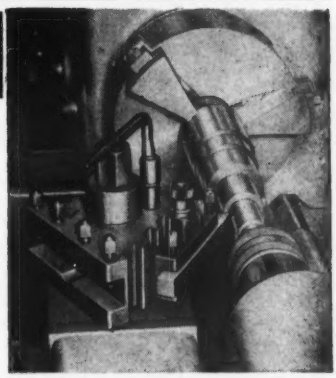

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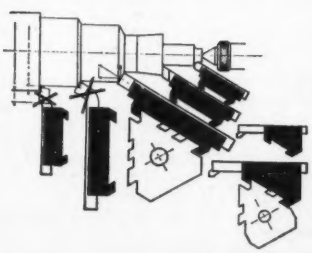

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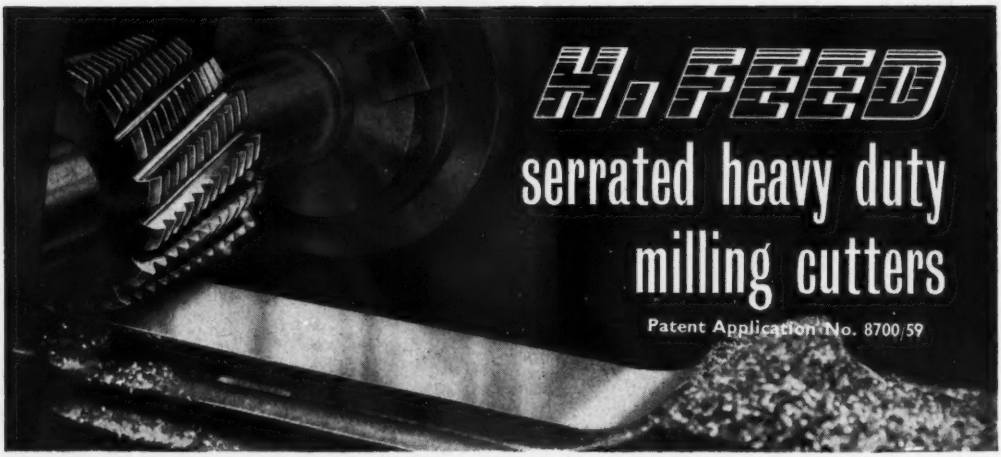

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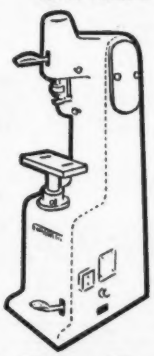

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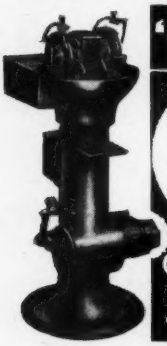

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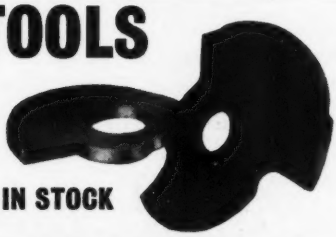

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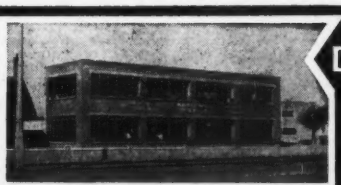
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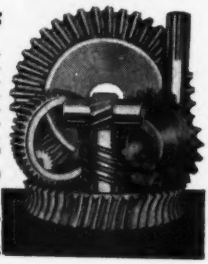

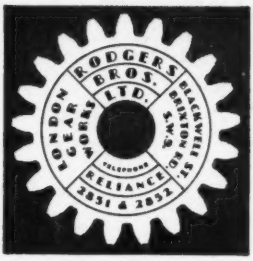

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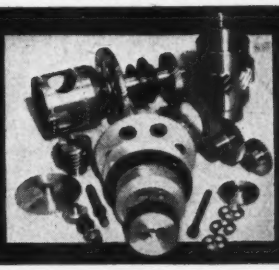

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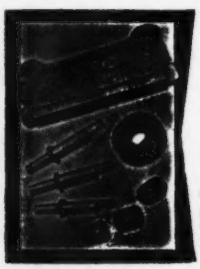

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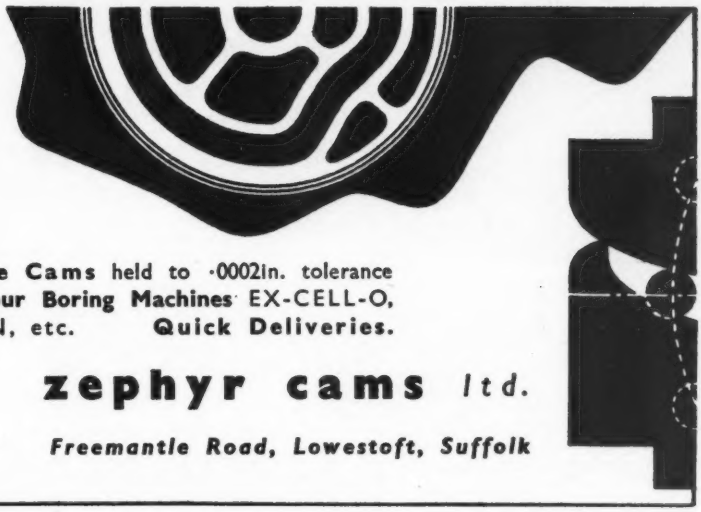

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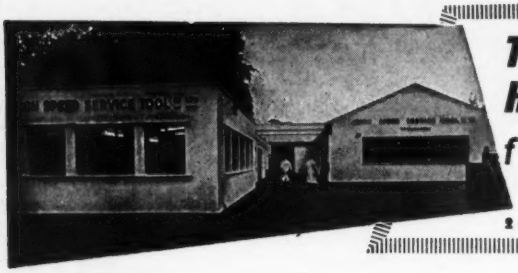

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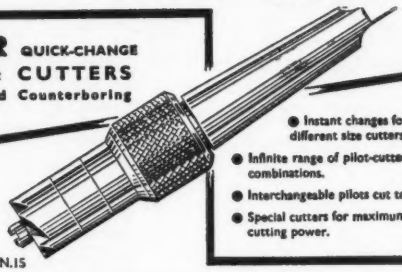

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ORMEROD 12in. stroke Slotting Machine, 27in. dia. rotary table.

LATHES

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CINCINNATI 10 ton Vert. Single Ram Hydraulic Surface Broaching Machine, 66in. stroke, 20in. × 20in. table.

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MOREY Model 2D Capstan.

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VICTORIA Model MI, Hori. Mill.
ARCHDALE Hori. Mill, 38in. × 10in. table.
REINECKER Vertical Mill, swivel head, 42in. × 13in. w/s table, p/f all ways.

GRINDING MACHINES

SCRIVENER No. 2 Centreless. Re-cond.
KAESER Hydraulic Surface Grinder, with 24in. × 8in. mag. chuck, coolant, etc.
CHURCHILL No. 1 Planetary Internal Cylinder Grinder.

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MISCELLANEOUS

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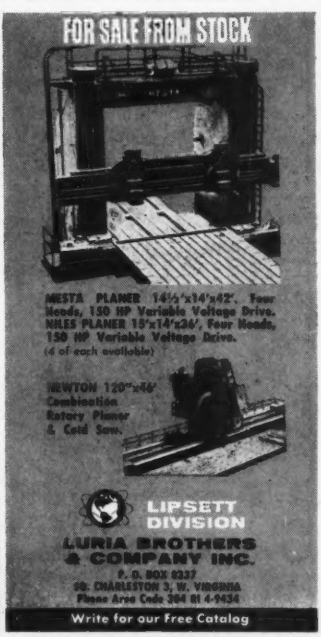
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VICTORIA V.2 Vertical.	Dec.
VICTORIA No. 2 Vertical Rapidmil.	Stock
VICTORIA V.3 Vertical.	Feb.
VICTORIA V.4 Vertical.	Dec.
W. & M. Turret Mill.	Dec.
BEAVER Turret Mill.	Stock
GIEWONT No. 2 Vertical.	Dec.
GIEWONT No. 4 Vertical.	Jan.
INDUMA 3U Universal	Dec.
INDUMA 3V Vertical.	Dec.
MAS FU.2A Universal.	Dec.

GRINDERS

BURDETT 18in. × 6in. Surface Grinder	Dec.
BURDETT 24in. × 8in. Surface Grinder	Dec.
ELB SW6 VA10 40in. × 12in. Surface Grinder.	Dec.
MYFORD MG.12 Cylindrical	Stock
RIBON RUR.500 Universal.	Dec.
EXCEL No. 1 10in. × 5in. Surface Grinder.	Stock
UNION Carbide Lapping Machine.	Stock
EXCEL No. 5 Tool & Cutter Grinder	Dec.

LATHES AND CAPSTANS

CARDIFF 7½in. × 40in. Major	Stock
W. & M. 70 Junior 7in. × 36in.	Dec.
COLCHESTER 7½in. Triumph.	Feb.
CARDIFF 9½in. × 48in. Prefect	Dec.
STANLEY 8½in. × 48in.	Jan.
STANLEY 10½in. × 56in.	Jan.
SV.18R 7½in. × 50in. Toolroom Lathe	Stock
BINNS & BERRY 12½in. × 7ft. 6in.	Dec.
RV.32 1¼in. Cap. Capstan Lathe	Stock

DRILLS

PROGRESS 4E. 1½in. Cap.	Stock
PROGRESS 3E. 1½in. Cap.	Stock
PROGRESS 3A. 1½in. Cap.	Stock
MAS VR.4 4ft. Radial Arm	Dec.
MAS VR.2 36in. Radial Arm.	Dec.

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PEARN RICHARDS No. 3 with 24in. dia. facing head. Table Area 7ft. 3in. × 5ft.
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—▶ **KEARNS** OC. 2¾in. Travelling Spindle (Choice of three).
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CHURCHILL 12in. × 50in. Hyd. Universal, internal spindle.
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JONES & SHIPMAN 8in. × 16in. Universal, internal spindle.
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MACHINES NOW IN STOCK

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RYDERMATIC No. 18 Vertical Automatics 60 H.P.

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MATHEYS Model FPN/28 Semi Jig Borer. (1956.)
PADDON Mk. 3 type WP Cylinder Re-Boring Machines.

HONING AND LAPPING

DELAPENA Honing Machine.

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AG-UR 1¼in. Capaci y Capstans. Full equipment (New).
AG-UR 2in. Capacity Capstans. Full equipment (New).
BOLEY-LEINEN Model ER15 ¼in. Capstan (Modern) (1953).
GISHOLT No. 3 Capstan Lathe.
HERBERT Model 22A Turret Lathe. 8¼in. Spindle Hole.
TIMBRELL & WRIGHT Turret Facing Lathe, 6in. Hollow Spindle.

CENTRE LATHES

WILLSON 7¼in. Newel Lathe.
SOUTHBEND 7in. Centre Lathe.
CRAVEN Heavy Duty Railway Wheel Lathe, swing 6ft. by 12ft., vee belt drive. Weight 25 tons.
New **CAPITOL** 9¼in. Centre Lathe Admitting 6ft. between centres.
FACEPLATE Lathe, 9ft. swing.
DEAN, SMITH & GRACE 8in. by 5ft. 6in. Centre Lathe.
7in. **COLCHESTER** Triumph Lathe.
4in. **HERBERT** Screw Cutting Lathe.

GRINDING MACHINES

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CRAVEN Heavy Duty Roll Grinding machine with capacity for rolls 42in. dia. by 12ft. between centres and fitted with automatic cambering. Will take rolls up to 25 tons weight. Fully motorised machine of modern design. Weight 25 tons.
ZENITH Model PH Horizontal Spindle Hydraulic Surface Grinder, 24in. by 8in. (1953).
LOTH Universal Grinder 10in. by 17in. (new).
Two **CINCINNATI** No. 2 Tool and Cutter Grinding Machines.
COVEL No. 2 Tool and Cutter Grinding Machine.
IMPERIA Tool and Cutter Grinder, Model M6AR. (1953).
MATRIX No. 16G Plain Straight Thread Grinder.
SCRIVENER No. 1 Centreless Grinder.
BLAKE No. 1 Tap Chamfering Machine (New).
MATRIX No. 6 Internal Thread Grinders 3in. by 10in.
HEALD Model 81 Sizematic Internal Grinder.

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VICTORIA Duplomatic Hydraulic Copy Milling Machine, 8in. by 8in. (New).

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PACERA ¼in. Bench and ½in. Pillar Drills (New).
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Two 30in. **TAGO** Radial Drills (New) £716.

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HANDS 4ft. by ¼in. Guillotine.
RHODES 6ft. by ¼in. Guillotine.

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FRITZ WERNER 2211 Universal Mill, 43in. by 12in. table.
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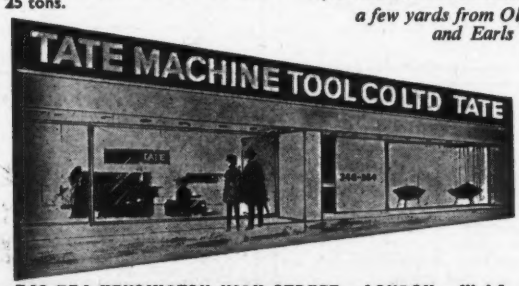

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CINCINNATI 18in. Manufacturing Mill. 36in. by 12in.
ADCOCK & SHIPLEY No. 3B Plain Mill, 36in. by 10in. table.

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DYE 12 by 3 by 3 Planing Machines, 2 toolbozes on rail (New).
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BROOK 18in. Shaping Machine.
KLOPP 22in. Shaping Machine.
TORPEX 22in. Shaping Machine.
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SAFAG Model 24 Automatic Cutter Relieving Machines.

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CORONA 1AX, No. 1 Morse Taper.
LELAND GIFFORD 2-sp., No. 2 M.T.
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JONES No. 13 Bandsaw.
WICKSTEAD No. 1 Hacksaw.
RAPIDOR 6in. Hacksaw.
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CHURCHILL HBY.
BRYANT 16/38 and 5.
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LUMSDEN Vert. 210 XXM.
ABRASIVE No. 34 Vertical Spindle.
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CHURCHILL PBH 12 × 36in. Univ.
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Motor	15 H.P.
Year of manufacture	1949

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CATCO No. 2 Surface.	£155
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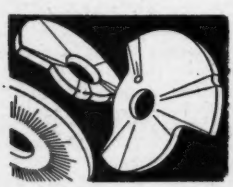

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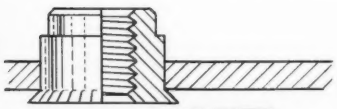

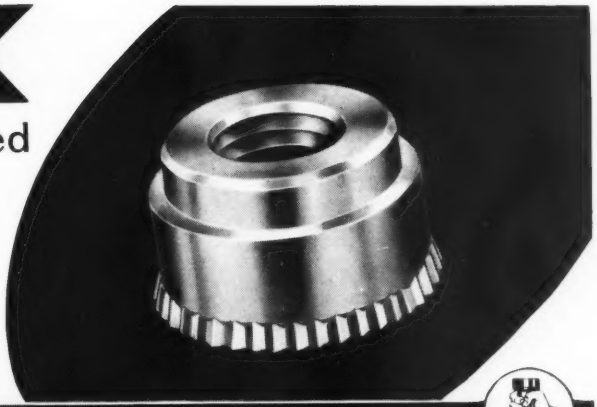

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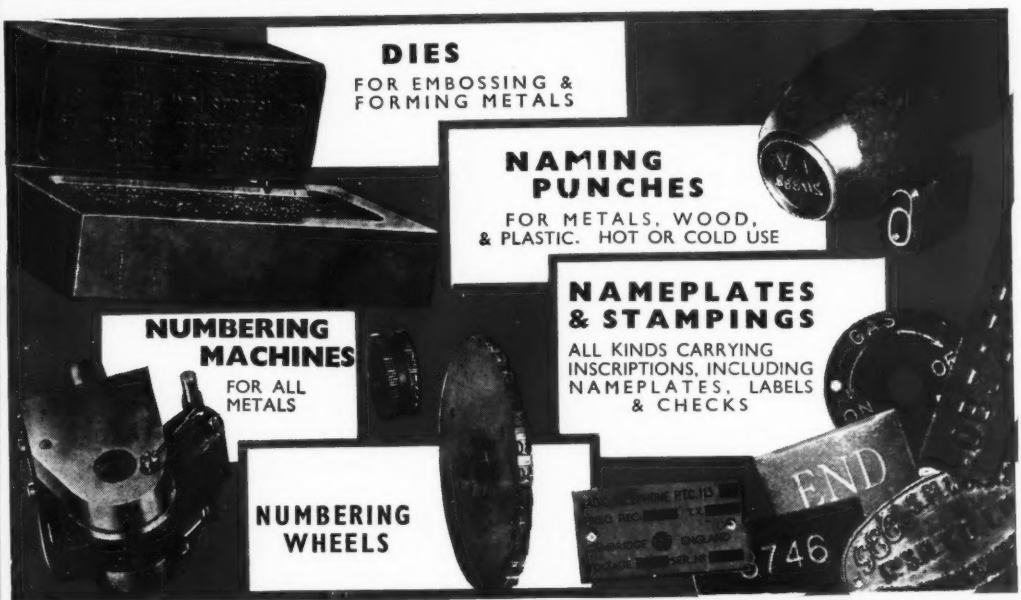
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